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June 1942

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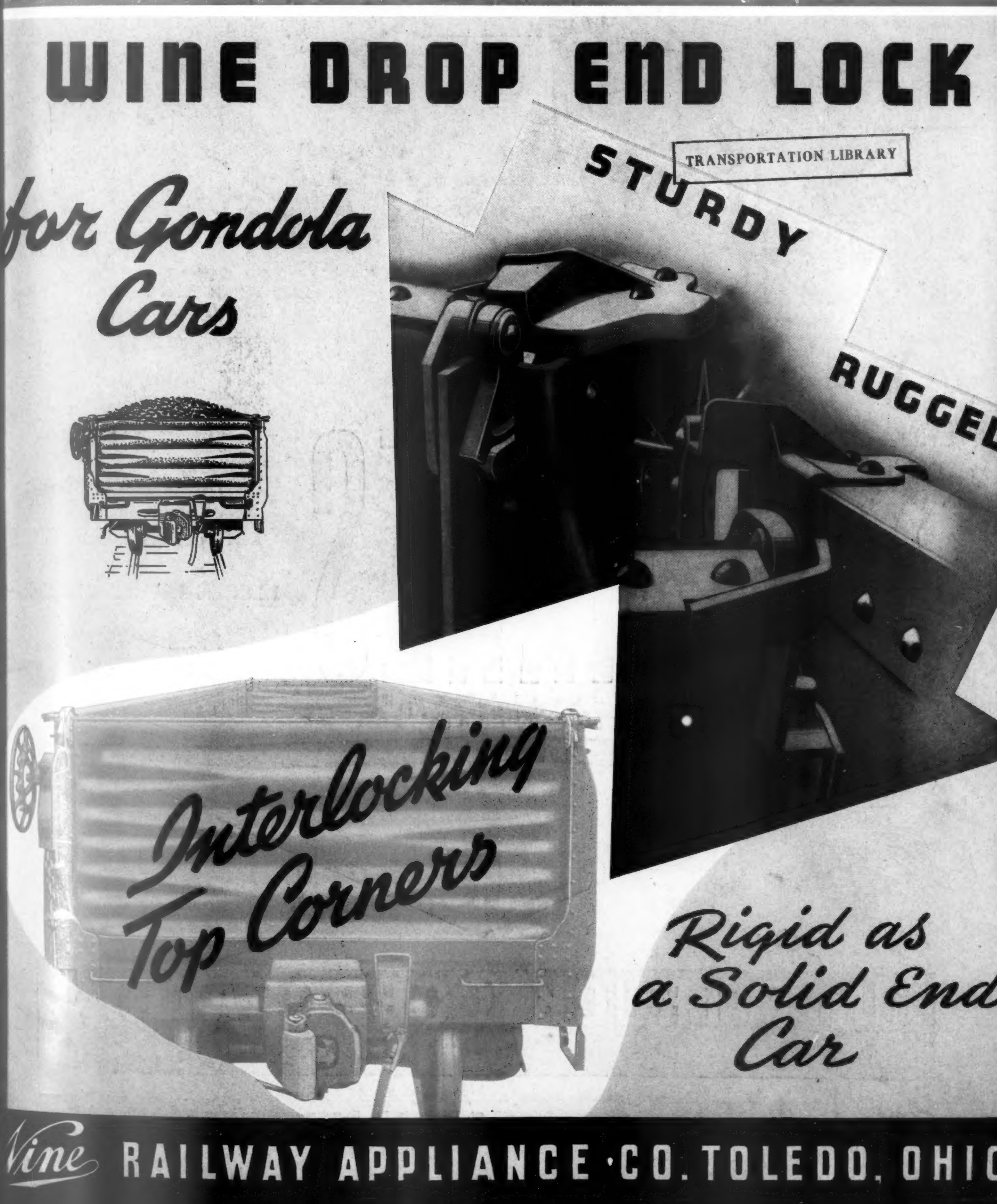

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RAILWAY
MECHANICAL ENGINEER

Fabricating a hopper-car side by electric arc welding

The Field for Welding*

By Leland E. Grant†

A survey of the possibilities offered by present techniques for restoring worn or broken parts, salvaging scrap materials, and reducing consumption of critical materials — Their attainment now hindered by opinions formed from obsolete practice—Coated electrodes a big factor in broadening the scope of the art

THE American railroads face three serious problems in their efforts to keep equipment in repair to meet the heavy demands of the present emergency. These problems involve materials, machines, and men. Essential materials, especially metals, are already difficult to obtain and this situation may be expected to grow progressively worse as the use in defense industries increases. A high priority rating may not be of much help if the shortage becomes so serious that there is an insufficient supply for strictly military requirements. Machine tools are in such demand for war work that they are not freely available even for the railroads and in addition many of them require so long in building that if ordered immediately they would not help the situation for some time to come. The shortage of skilled labor is acute as evidenced by the recall of pensioned employees. The railroads must contend with active competition for any skilled labor that is available or may become so through fluctuations in the industries.

Under present conditions, therefore, it is essential to make the best possible use of the materials, men, and machines. Metal parts that can be salvaged, even at a reclamation cost greater than that for the new part, ought not be scrapped. Adoption of methods that will result in a reduction in the amount of processing on machine tools will assist not only in making the best possible use of the tools but also of the skilled mechanics required to operate them. It is apparent that a program which will save material and reduce the amount of machine tool work will not only save the railroads money but will help in keeping the equipment in shape and contribute to the defense of America.

* This article was entered in the *Railway Mechanical Engineer* prize competition on ways in which the mechanical department can secure best results from available facilities and equipment which was announced in the October, 1941, issue.

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Welding Possibilities

It is the opinion of the author that welding, combined with oxy-acetylene cutting, offers almost limitless possibilities in establishing such a program. The welding torch and cutting torch are two of the most powerful tools ever placed in the hands of workmen. Only imagination and initiative are necessary to develop the tremendous potentialities inherent in them, but before they will come to be used to the maximum possible extent some erroneous impressions about their limitations will have to be corrected. Unfavorable opinions concerning the value and dependability of welds, based probably upon the characteristics of welds made with bare wire, will need to be discarded. New and accurate ideas founded on the accomplishments possible with modern machines and electrodes should replace them.

Supervisors, department heads, and others who share the responsibility for maintaining the splendid performance record of the railroads, need only look to modern ships, aeroplanes, tanks, guns and even the machine tools with which they are very familiar, to see evidence of many successful applications of welding. In the face of such evidence there can be no excuse for not recognizing the possibilities for economy in the mechanical department by more extensive application of welding and cutting. *If all the American railroads were to adopt immediately only those cutting and welding procedures now in successful use in the various railroad shops of the country, the aggregate savings would be enormous.*

One of the most important stumbling blocks preventing the adoption of such a program is the innate characteristic trait of the human mind to resist change. A clear recognition of this strange reluctance to accept new ideas, coupled with a determined effort to overcome it, would quickly lead to an accurate evaluation of welding processes and their possible application to mechanical department problems.

It is not the author's purpose in this paper to list all the various parts that can be welded and to give detailed procedures for so doing. Rather it is desired to show how completely and effectively cutting and welding can serve in overcoming the handicaps in maintenance that have developed or will develop as a result of the current defense program. If a proper appreciation of these methods is attained, applications will follow in due course.

The term welding is intended to include both electric and gas methods. The electric methods will be found the most economical in general but gas welding has definite fields of usefulness. Details of welding and cutting procedures are not included because they are readily obtainable elsewhere. However, some of the general factors pertaining to all welding are discussed, particularly their influence on the success or failure of a welding program. Some of the reasons for failure in the past are explained in order to account for the unjustified poor opinion of welding held by some. The favorable effect of an expanded welding program on the machine tool and skilled labor problem is noted.

Handicapped by Misunderstanding

If the use of welding is to be extended on the railroads it will not do to turn down a proposal arbitrarily just because someone has previously tried it and says, "It can't be done!" Possibly one reason it couldn't be done is because too much was left to the discretion of the operator; but more about this angle later. Also there may have been unfavorable conditions existing when the job was first tried that have changed since. Welding that was not justified for economic reasons when new material was available may, and probably will, appear in an altogether different light now.

On the other hand success may depend upon proper pre-heating, stress relieving, annealing or other heat treatment. Sometimes the use of electrodes producing welds meeting certain physical requirements is a deciding factor. Control of warping by the use of jigs or a definite sequence for making the welds may be essential. Many factors may need to be given consideration but basically this part of a welding program does not differ

Welding on a push-pole pocket

from many other mechanical department problems. It entails that supervisors shall understand what must be done, see that the welders also understand and that they use the best materials and methods indicated.

Sources of Information

There are a number of sources of information that may be used for assistance in new applications and for ideas pertaining to possible applications of welding. The A. A. R. Manual on Welding should be found especially useful for this. It contains detailed descriptions of methods for cutting and welding many metals as well as examples of numerous applications on the railroads. Other sources of information are the Handbook and monthly Journal of the American Welding Society, handbooks published by manufacturers of welding machines and supplies, bulletins of some steel companies, and articles that appear in the *Railway Mechanical Engineer*.

Frequently it is possible to obtain valuable advice and assistance from the service men of concerns furnishing welding equipment. Best of all it will frequently be found possible to see how some other railroad is doing the particular job in which one is interested. As a last resort the trial-and-error method can be used and in such cases it will often be helpful to have the cooperation of the engineering department. There will also be times when it will be advisable to send some welding jobs to outside concerns which have facilities, machines and methods that have been especially developed for certain kinds of work. There should be no hesitation about doing this even if the shop does have an excellent welding record. There are limits to what can be done without essential tools.

Careful Instructions Necessary

It is common practice in some places to turn a new job over to the shop with instructions only to "weld it." It is a definite mistake to follow any such practice. This custom probably originated as a result of the early applications of welding. In the beginning welding was employed principally for repairing worn or broken parts. The men in the shop did a lot of welding that the engineers knew little or nothing about. The welders learned by experience, some of it unhappy, what they could or could not do successfully. It was a natural consequence that when the engineers began to apply welding the shop men could tell them what to do. Under these circumstances the welders were allowed considerable freedom in manipulation.

Now that welding has grown to a larger and more exacting field it is time to realize that the old practices may need to be changed. The engineer must contribute his share in the design, leaving to the welder only the responsibility for making good welds where and as the engineer indicates on his drawings. It is no longer practicable to permit the welder to decide how much welding should be done. He does not have sufficient information to determine how much welding is required. It is just as unsound a practice to leave the details as to size and length of welds to the operator as it would be to permit the riveting gang to decide what size and how many rivets to drive in a boiler. The strength might be adequate but the cost could hardly be expected to reach a minimum under such conditions.

It is very essential that new applications of welding be soundly engineered. To fail to do so is to invite unsatisfactory results. The size, length and location of all welds should be specified. The size and type of electrode, details of the various joints, and any heat treatment necessary should all be put on the drawing. This is a simple matter if the symbols of the American Welding Society are used. The objective should be to have the engineering just as complete and detailed as it would be for a similar job to be riveted. It is necessary that this be done for welding to compete successfully with other methods of fabrication or repair.

If the engineering is neglected there will be failures and they will be called welding failures when fundamentally they are due to insufficient engineering. If welding is properly applied it will usually result in economy with satisfaction in service.

Advantages of Welding for Repair Work

One of the marked advantages of welding is speed. Parts can be repaired quickly, frequently without being removed from the locomotive or other unit as the case may be. Not only is the time and labor necessary to re-

A heavy cast-steel weld

move and replace them saved but also the equipment is held out of service a minimum length of time. Repairing by welding usually saves some machining also because if new parts are used they are quite likely to require some machine work to fit them for service. Welding thus saves the material and at the same time reduces the burden on machine tools.

An excellent example of how welding may lead to a reduction in machining can be found in the electric arc application of bronze to driving boxes instead of casting it. In the method of casting the bronze it is necessary to machine dovetailed grooves into the box for mechanical anchorage of the bronze. When the surfaces are worn down it is necessary to remove the old bronze by machining so that a new wearing plate can be cast. In the welding method no grooves need be machined; the welding fuses the bronze to the steel surface of the box. When

the bronze has become worn a new layer is deposited on the old with only a slight surplus. One light cut to restore the desired dimensions is the only machining necessary. Machining of the steel is eliminated so far as the wearing faces are concerned and that on the bronze is reduced to a minimum.

Old boxes with grooves already cut can be adapted for welding by putting in steel plates or filling the grooves solid by welding before depositing the bronze. The welding method, therefore, has a definite advantage over the casting method in reducing the machining, whether bronze or babbitt is cast on the box. In the aggregate such cases sensibly reduce the amount of machine work that must be done. With the shortage of copper and tin the electric arc method of maintaining driving boxes should become even more popular as it requires much less bronze than the casting method.

The difficulty in obtaining steel castings at the present time and the possibility that there will be even more difficulty in the near future will necessarily lead to much more extensive reclamation of castings and very likely to the replacement of some by weldments fabricated from plates and shapes. In this field the cutting and welding torches can be the source of large savings. Parts can be cut, bent to shape so far as practicable and then welded together. In many cases such weldments will be cheaper, lighter and easier to repair subsequently than the castings they replace. They will be just as strong and somewhat more rigid than some assemblies having castings riveted in place.

Weldments may also have advantages in machining as the very nature of the material used in fabricating them lends itself well to producing flat, true surfaces which by careful welding can be held close to specified dimensions. Machine operations can be either eliminated entirely or reduced to a minimum. It is obvious that the successful and economical use of weldments to replace castings will depend upon careful engineering. Welding will be the simplest part of the operation.

How to Weld a Crack

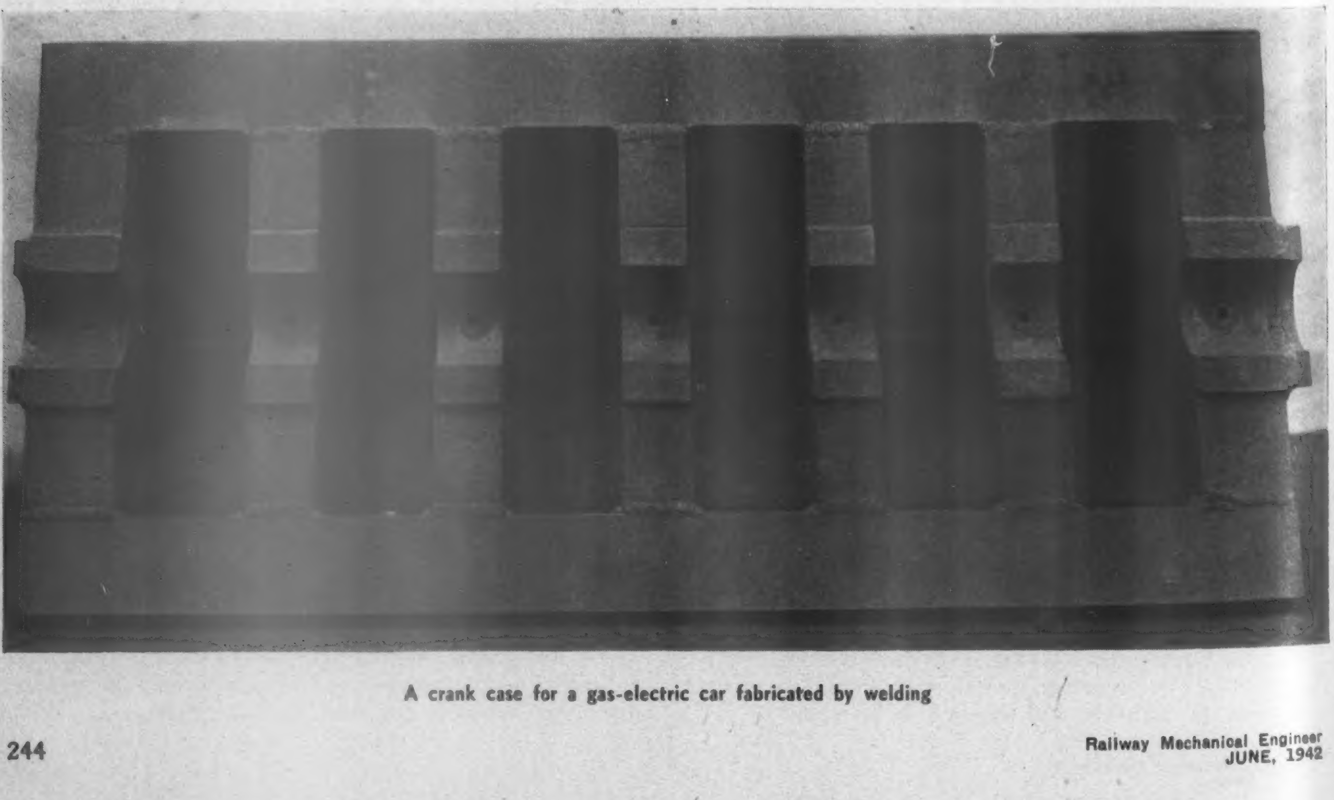
In repair work careful attention must be given to certain important details that frequently are neglected, overlooked, or considered inconsequential. For example, anyone familiar with welding will see failures due to improper procedure in welding cracks. Some are due to just depositing a single bead over the crack, others to veeing only part way through the section before welding. In such cases there is a crack existing from ten to ninety or more per cent through the section when the welding is completed. It should be clear that if the original whole section could not carry the load without failing, less metal than this will not carry it either. The proper course is to vee completely through the section so that the weld will have the same thickness as the original metal plus a slight reinforcement at the surface. This will eliminate the stress concentration condition that exists when part of the crack is left.

Cracks in cast iron often are very difficult to trace to their ultimate end. Seldom does the apparent end coincide with the actual end. Chipping is the most satisfactory way to prepare cracks in cast iron for welding but it tends to cover up the crack. It is best, therefore, to warm the metal with a torch flame to determine if all the crack has been removed. On a clean sand-blasted surface this heating will generally show if any of the crack remains. In any event it is wise to chip an inch or more beyond the apparent terminus of the crack or drill a hole through the casting at about the same distance.

Importance of Preparing

Proper preheating and subsequent cooling are especially important when welding cast or malleable iron, alloy steels or steel with more than about 0.30 per cent carbon. The heating prevents cracking, both microscopic and macroscopic, as well as preventing hardening that might interfere with subsequent machining. In the case of gas welding, preheating may pay dividends in the saving of time and expensive compressed gases. Charcoal or city gas are cheaper fuel sources than cylinder gases. Where routine work, such as building up pistons, is being done a suitable furnace for preheating combined with a device for rotating the piston will save money and enable the welder to do better work.

It is not necessary to discuss the importance of undercutting, slag inclusions, cracks, or some of the other weld defects that are visible on inspection. The harm they may do is well understood and as they are perfectly



A crank case for a gas-electric car fabricated by welding

obvious in the finished weld they can readily be corrected. They should not be tolerated.

How to Make Joints

In the early days of welding it was customary to bevel plates 45 deg. on each side of the joint. An included angle of about 90 deg. was necessary to avoid arcing of the bare welding rod on the edge of the plate or part way down in the joint. Now that coated electrodes are almost universally used for joints, or at least should be, this practice needs to be changed. The vee should be reduced to the minimum that it is possible to use for the particular conditions. There are no inherent advantages in a wide vee with coated rods but there are disadvantages. The wide weld costs a great deal more to make and both shrinkage and warping become more serious the larger the amount of deposited metal.

By using a vee of about 45 deg. included angle the weld can be made cheaper with coated rod than the larger weld could be made with bare wire. The weld is of course much superior when made with a coated electrode. The narrow opening is perfectly practical since the first pass can be made without any danger of arcing on the edges, the coating on the rod being a non-conductor. Careful attention to the size and shapes of the joint openings will pay dividends in lower costs and better welds. On heavy plates the J or U type of joint opening is usually the most economical.

Positioning Devices

The use of positioning devices to permit down-hand welding whenever possible should be encouraged. Much of the welding done in the mechanical department does not at first appear to be well adapted to positioning. A little ingenuity will show that much of it could be done better on a positioning device; the welders have simply become accustomed to turning the work by hand or making the welds as they come to them. If extensive reclamation work or fabrication of new parts is undertaken, positioning by means of either home-made jigs or commercial positioning tables will not only be found feasible but possibly essential to speed up the work.

Comparatively unskilled operators can do very satisfactory work if all the welding is down hand. Positioning of the work will thus lead to better welding and at the same time release the skilled welders for the work that cannot be positioned. The electrodes available for down-hand welding are fast and make welds with excellent physical properties and appearance. In down-hand welding it is possible to use rods that are larger in diameter and longer than those used for all-position work. This leads to economy in the amount of welding rod used. The stub discarded will be the same length whether the original rod was long or short. The unavoidable waste is significantly less with the longer electrodes.

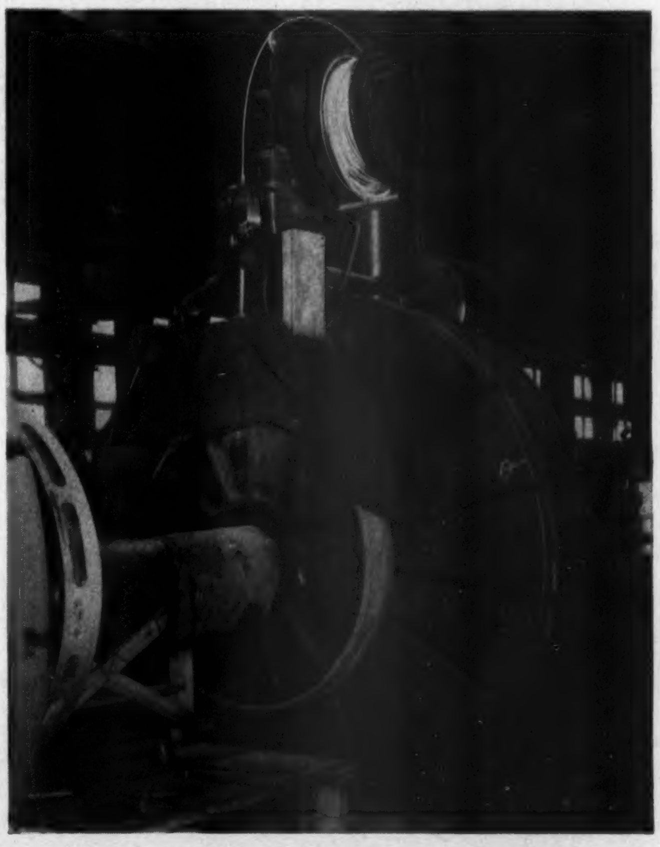
How About Trained Welders?

It may at first appear that it will be difficult to obtain enough trained welders for any extensive expansion of welding. This will not prove to be the case. The railroads have many men doing welding only intermittently who could well be assigned to welding continuously. They may appear somewhat inept in the beginning but in general will show remarkable improvement when welding regularly. Welding is an art that involves manual skill and hence requires constant practice for the best results. Workers who have been at it a long time, as the majority of railroad welders have, possess the skill even though they may be handicapped in making the most of it through lack of knowledge of certain fundamentals of operating technique. This is especially true of the men who learned to weld with uncoated electrodes, in many cases with no assistance whatever. These men can quickly be taught some of the essential details of manipulation with coated rods and become very proficient welders. They have the skill but do not know how to apply it. Welding with bare wire requires more skill than for coated rods but the latter involve a different method of working.

If it should be necessary to hire new welders it will not be any more difficult to find trained men for this work than it would be to find skilled machinists or other classes of skilled labor.

Substantial Net Savings

Welding machines are not particularly difficult to obtain at present but in many cases no additional machines will be required. Those already available will be sufficient if put on an "all-out" basis. The welding-rod manufacturers appear to be able to take care of the ordinary rod requirements as long as they can obtain the necessary wire. In view of the immense tonnage of steel that can be saved for further use by welding, it appears safe to assume that the relatively small amount of steel needed for welding rods will be made available for the railroads.



Building up a driving-wheel center by machine welding

When the railroads do expand their welding a lot of material will be saved for further use that in the past has been scrapped. The suggestions along this line in the Walt Wyre story in the December number of *Railway Mechanical Engineer* will not seem far fetched. Much material could be saved by means of a cutting torch and a little ingenuity such as that displayed by Foreman Evans. For example, wide sheets which are now difficult to get could be made by welding smaller sheets together. This, of course, would only be possible where welding is not prohibited, as for smokeboxes. Such things as dies can be saved by the use of only a few rods of special

hard-surfacing electrodes. A little Stellite or carbide powder applied with a torch may lengthen the life of parts subject to local wear to such an extent that the relatively high cost of the overlay is insignificant. There are hundreds of such applications and each shop will find numerous ones of its own. If a clearing house for such ideas could be established by a magazine such as *Railway Mechanical Engineer* many profitable suggestions could be passed along.

The American railroads were among the first industries to adopt the welding and cutting torches. There is no reason why they should not continue to be leaders. Mistakes have been made in the applications of welding and undoubtedly a lot more of them will be made. Some poor welding was done in the early days but this is typical of the development of any new art or industry. One need look only as far as the field of reinforced concrete construction for a very similar example.

Welding is young and still growing rapidly but already there is an abundance of proof that modern welding technique will produce dependable joints. Lack of faith in welding cannot be justified in the face of the record. Mistakes made in the past should not stop progress, nor will they as long as managers and engineers retain the rights and privileges assured them in a democracy. It is exceedingly appropriate that welding should play a very important part in the preservation of the democracies.

Improved Technique Increases Welding Speed

Increased arc speed in welding a 3/8-in. horizontal fillet is now possible, according to Lincoln Electric Company technicians who have worked on the development of the "Fleet-Fillet" procedure. Conventional methods average about 30 ft. per hour of deposited metal but can be increased to as much as 65 ft. per hour using proper type shielded electrodes with an increase in speed of travel and increase in current. Penetration at the root of the weld actually increases as indicated in Tables I and II.

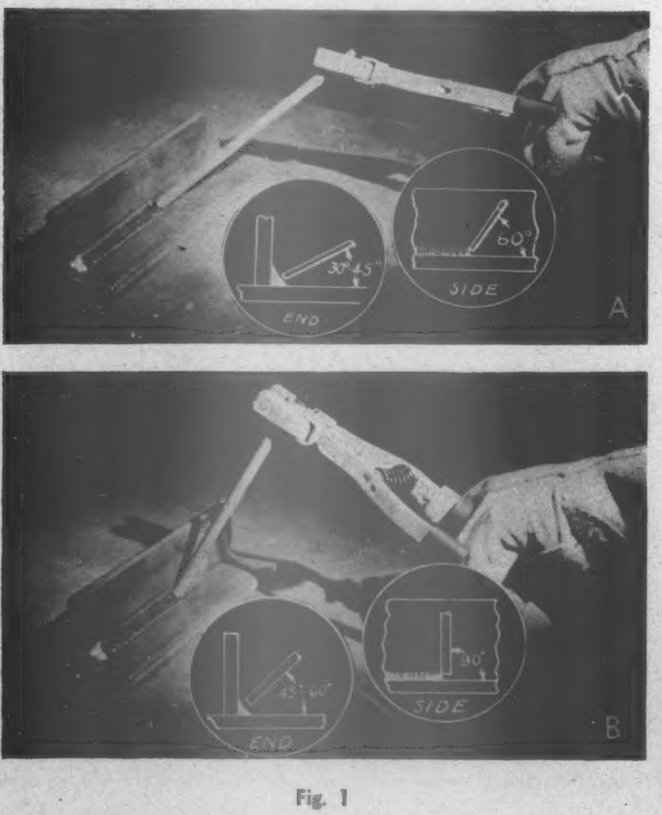


Fig. 1

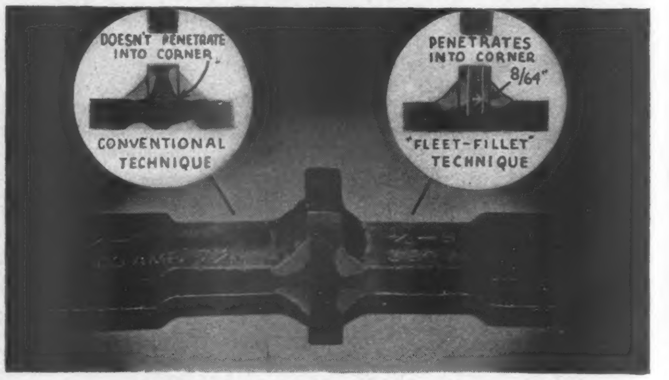


Fig. 2

Procedure in applying the new technique consists of four factors: (1) Hold the electrode at an angle as shown in Fig. 1(b); (2) in general, use higher currents; (3) advance the electrode at higher speed; and, (4) use electrodes recommended for the technique. In following these rules an economically practical average between the ideal fillet and the conventional fillet is obtained.

Table I—Comparison Tests for Single-Pass Horizontal Fillets (Not Positioned) Made by Conventional and "Fleet-Fillet" Techniques

	Conventional method, Fig. 3(*a*)	"Fleet-Fillet" method, Fig. 3(*b*)	"Fleet-Fillet" method, Fig. 3(*c*)
Electrode (Fleet-weld), in.	1/4	1/4	1/4
Current, direct; electrode negative, amp.	300	300	360
Arc speed, in. per min.	7	10	12
Size of fillet, as now defined, in.	24/64	17/64	18/64
Apparent throat 0.707 x (size of fillet), in.	17/64	12/64	13/64
True or effective throat, in.	17/64	17/64	20/64
Penetration beyond root or corner, in.	0	5/64	8/64
Ultimate load of joint in lb. per in. of length	27,000	27,000	Plate failed at 30,000
Comparative Costs			
Pounds of electrode per foot of weld	0.37	0.26	0.26
Electrode cost per foot of weld*, cents	2.2	1.5	1.5
Labor cost per foot of weld†, cents	5.8	4.0	3.3
Overhead, 100 per cent of labor cost, cents	5.8	4.0	3.3
Total cost, Labor, electrode and overhead, cents	13.8	9.5	8.1

* Electrode cost figured at 6 cents per lb.
† Labor cost figured at $1.00 per hr. with 50 per cent operating factor.

Two pairs of fillets, one made by conventional methods, and the other following the "fleet-fillet" technique are shown in Fig. 2. The fillet made by the new method has only 70 per cent as much deposited metal as the other, yet it has 15 per cent greater strength.

Tables I and II give comparisons showing the effect of arc speed on the effective throat of the weld; the amount of penetration beyond the root, or corner; strength of the weld; amount of electrode, and welding cost. Table I gives comparisons between conventional and "fleet-fillet" specimens welded in the horizontal position while Table II covers specimens positioned for downhand welding.

In conventional welding procedures, the electrode is held at approximately 45 deg. with the horizontal plate and at approximately 60 deg. to the line of weld with the end pointing backward, Fig. 1 (a). The arc is held short but speed of travel is usually so slow that the electrode must be held out from the plates being jointed to

keep the end of the electrode from dipping into the molten pool. In the new fillet technique the average position of the electrode is about perpendicular to the line of the weld at from 45 deg. to 60 deg. with the horizontal plate, Fig. 1 (b). The arc is so short that the electrode coating practically touches the plate. It is not objectionable to rest the coating lightly against the plates, but if it is forced against them a rough bead is likely to be obtained.

The conventional method of building up a multiple-pass horizontal fillet is shown in Fig. 5 (a), with the beads laid from the top down. With the "fleet-fillet" technique beads are laid from the bottom upward, as

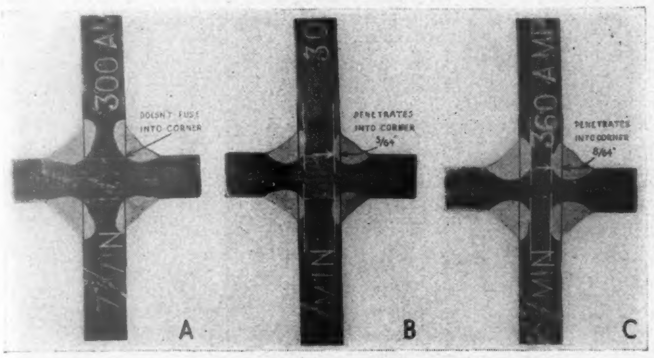


Fig. 3

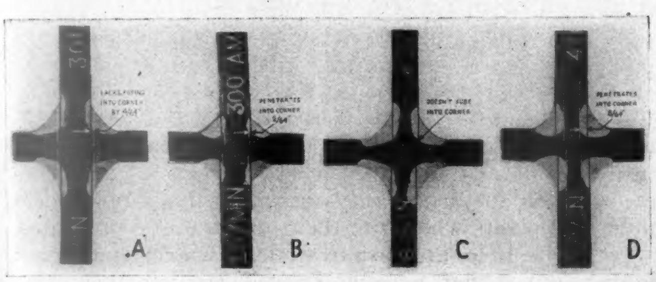


Fig. 4

shown in Fig. 5 (b). This method provides a flat horizontal surface upon which to place succeeding beads,

Table II—Comparison Tests for Single-Pass Positioned Fillets Made by Conventional and Fleet-Fillet Techniques

	Conventional method, Fig. 4(*a*)	"Fleet-fillet" method, Fig. 4(*b*)	Conventional method, Fig. 4(*c*)	"Fleet-fillet" method, Fig. 4(*d*)
Electrode (Fleetweld), in.	¼	¼	¼	¼
Current, direct; electrode negative, amp.	300	300	400	400
Arc speed, in. per min.	6	10	6	12
Size of fillet as now defined, in.	24/64	18/64	28/64	20/64
Apparent throat 0.707 x (size of fillet), in.	17/64	13/64	20/64	14/64
True or effective throat, in.	15/64	15/64	20/64	20/64
Penetration beyond root or corner	Missed fusing to corner by 4/64 in.	Penetration 2/64 in.	No penetration	Penetration 8/64 in.
Ultimate load of joint, lb. per in. of length	27,000	27,000	Plate failed at 30,000	Plate failed at 30,000
COMPARATIVE COSTS				
Pounds of electrode per foot of weld	0.43	0.26	0.57	0.28
Electrode cost per foot of weld*, cents	2.6	1.5	3.4	1.7
Labor cost per foot of weld†, cents	6.6	4.0	6.6	3.3
Overhead, 100 per cent of labor cost, cents	6.6	4.0	6.6	3.3
Total cost; labor, electrodes and overhead, cents	15.8	9.5	16.6	8.3

* Electrode cost figured at 6 cents per lb.
† Labor cost figured at $1.00 per hr. with 50 per cent operating factor.

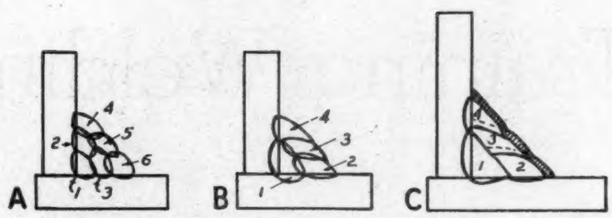


Fig. 5

permitting higher currents and faster welding. The first bead is laid in the corner using fairly high current and speed. Subsequent beads are applied with the electrode held at an angle of 70 deg. to 80 deg. with the horizontal plate and the line of weld except the beads against the vertical plate in which case the electrode should be at about a 45 deg. angle.

Using this new technique on multiple-pass welding, the slag is left on the bead in order to provide a dam to keep the metal from running off the edge of the previous bead. This is illustrated in Fig. 5 (c). The slag is not removed until after each layer of beads has been completed. In other words, for the weld shown in Fig. 5 (c), the slag is removed after the completion of beads No. 1 and No. 4. This procedure saves man-hours in the cleaning of the weld and also facilitates and speeds up the welding operation while making possible a smoother weld. Any number of layers may be applied in this manner. A weld containing 16 passes joining 1¼-in. plates is shown in Fig. 6.

Regardless of the nature of the fillet welding, i.e., whether it be single-pass, either horizontal or positioned, or multiple-pass, either horizontal or positioned, the new

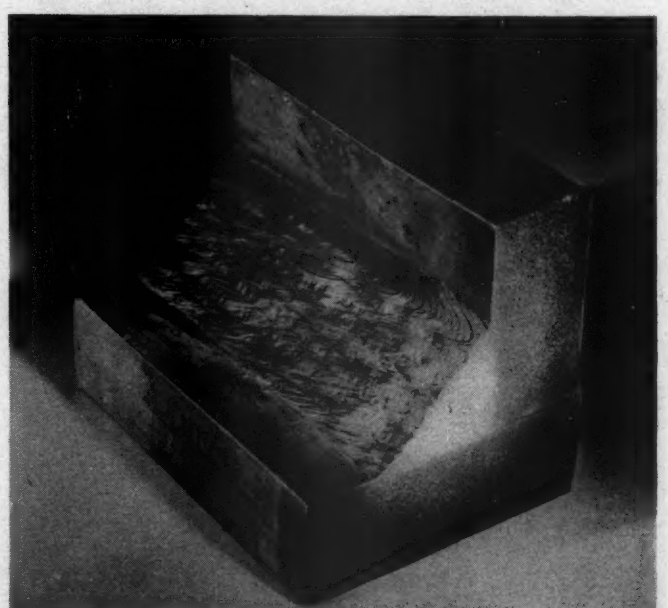


Fig. 6

"fleet-fillet" technique permits welding speeds up to 100 per cent faster than conventional procedure. The penetrations obtained are illustrated in Figs. 3 and 4 on specimens welded conventionally and with the faster recommended practice. Fig. 3 (a) and Fig. 4 (a and c) were produced according to conventional practice; while Fig. 3 (b and c) and Fig. 4 (b and d) illustrate "fleet-fillet" technique. Half-inch plates were used for these test specimens.

Training Welding Operators

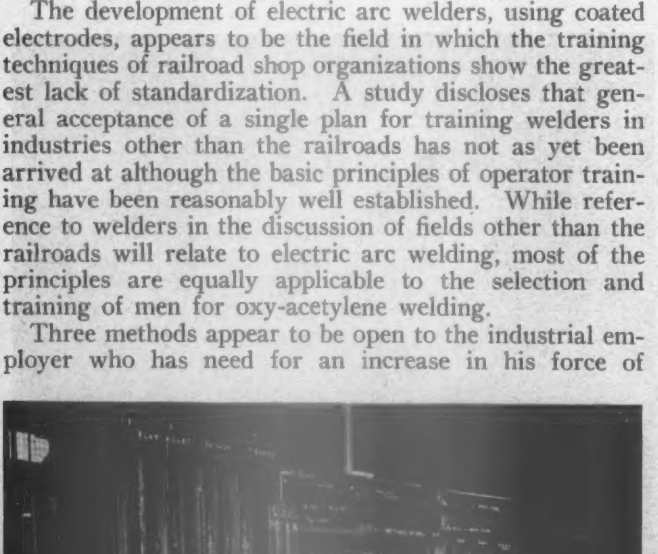
Care in selection of trainees and instructors important — Training of limited scope often satisfactory — Safety instruction a vital part of any program

TRAINING of welders is not a recent development in nor addition to the duties of railway mechanical officers, supervisors and foremen. Few industries have had as large a part as the railroads in developing the techniques of welding and the education of welders in those techniques. The early history of oxy-acetylene welding is largely a history of changing processes in railway shops. Later years saw the introduction of electric-arc welding with the use of the bare electrode and, in this field, too, the railroads, especially their boiler shops, were prominent in working out procedures and qualifying operators. Training welders in the early years was mostly a matter of selecting men who were willing to try and letting them work out their own salvation within the somewhat elastic limits of quality of workmanship which were in force. Many of these men, keeping abreast of the times, have developed into the welding foremen and leaders in service in railroad shops today.

Most of the railroads have operating arrangements with contract companies in the oxy-acetylene field whereby service engineers and instructors are always available to give any necessary advice or assistance and, in many cases, to perform the more difficult welding jobs. As a result of the longer familiarity of railroads with the oxy-acetylene process and the close supervision exercised by contract company representatives, there are probably enough well-qualified gas welders on most railroads.

The development of electric arc welders, using coated electrodes, appears to be the field in which the training techniques of railroad shop organizations show the greatest lack of standardization. A study discloses that general acceptance of a single plan for training welders in industries other than the railroads has not as yet been arrived at although the basic principles of operator training have been reasonably well established. While reference to welders in the discussion of fields other than the railroads will relate to electric arc welding, most of the principles are equally applicable to the selection and training of men for oxy-acetylene welding.

Three methods appear to be open to the industrial employer who has need for an increase in his force of welders: training in industry, selection of private welding-school graduates, or hiring of public vocational school trainees. Each method has its advocates and generally the determination is made with reference to previous experience or the reported experiences of other employers. Where the need for welders is great all three methods may be followed.



Sample welds mounted on a demonstration panel in a plant of the Baldwin Locomotive Works. Trainees can check their own results against approved samples

Training men in service rarely aims at more than the development of satisfactory competency in the performance of one or two operations. Workers may be further trained as they display interest but the ruling factor in their early training is getting them into production as soon as possible. Most private schools and many of the publicly supported institutions give complete training in all fields of welding practice and include some work in welding theory. National-defense training courses usually aim at teaching the types of welding commonly used in the plants of the locality where the schools are operated. Their method is very similar to that employed in industrial plants which run their own training programs. Advanced courses are open to students who are interested in furthering their welding knowledge after they have obtained employment. In all cases, however, the Code of Minimum Requirements for Instruction of Welding Operators, published by the American Welding Society can be followed as representing the consensus of opinion of welding engineers for guidance in a training program.

Who Can Be Trained

Hard and fast rules to be followed in the selection of trainable men have not been laid down, but a few standards are generally accepted. Physical characteristics often determine the success or failure of a trainee. Men of average size and weight seem more adaptable to welding operations that require movement on the job or adjustment to difficult working positions. Normal good health, good hearing, good natural, or properly corrected, eyesight and, probably, freedom from respiratory ailments must be demanded of trainees. Good hearing is important as a safety factor especially where the work being performed is done under noisy conditions; warnings often can be given only once and good hearing and immediate response may avoid accidents.

Good eyesight, natural or corrected, is necessary for the production of the best quality of work. Constant observation of an arc through protective glasses is a strain which may damage eyesight where an original weak eye condition exists. There is no evidence that welding is harmful to normal vision but if the operator requires corrective lenses they should be worn under the helmet or goggles at all times.

Less is known of the ill effects resulting from respira-

tory weaknesses. The best possible ventilation should be provided at all times but complaints from workers will be less frequent if all operators have good lungs with clear nasal and respiratory passages.

The age of men selected for training has been found to be a factor which affects the likelihood of their success in acquiring competency. Greatest progress and fastest rate of learning is among men between 18 and 35; between 35 and 40 learning may proceed more slowly but satisfactory results are achieved, especially where there is no attempt to create all-around welders but merely to give training in a small number of routine processes.

Welders trained by the Baldwin Locomotive Works who are now engaged in war production work

The field for men over 40 has been restricted because they have been considered less adaptable to change from previous work habits and because in this group many of the physical factors affecting competency lessen the chance for success in developing good operators.

Intelligence and Mechanical Aptitude

Proficient welders cannot be developed in any training program unless some attempt is made to evaluate initially their prospects of success. Elaborate tests to determine intelligence and mechanical aptitude do not appear to be necessary in selection of trainees although, if they are used, the class selected by test will produce a greater number of skilled operators than a group picked by the more generally applied methods of choosing workers. Faster learning and better end results are achieved. This is especially important in plants which undertake to train their own men; the cost of instruction is high, materials and machines, with their maintenance, are expensive. Also, less supervision will be required and less work will be rejected or will require re-welding when the trainee goes on production welding. Another important advantage in carefully choosing trainees is that the possibility of up-grading such employees is much greater than with a group which might meet the minimum requirements for the least difficult shop operations.

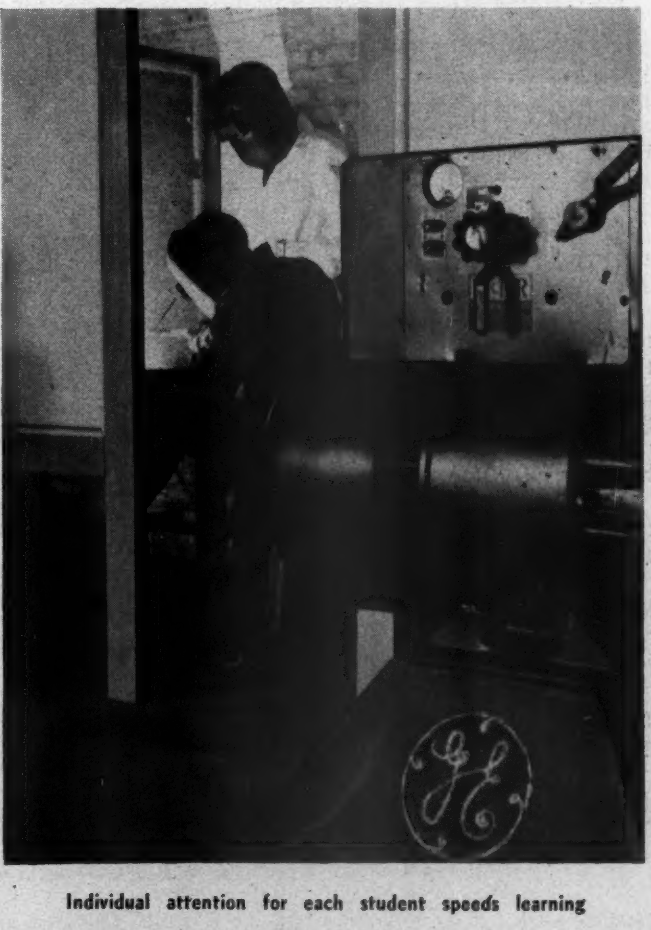
Instructors

The usefulness of any adequate system of picking men for training will be destroyed or seriously impaired by failure to furnish competent instructors. It is not necessary that such instructors be trained in formal educational methods but they must have the ability to impart to others the knowledge which they have gained themselves through training and experience. Lacking any more exact method, the policy seems to be to advance men who are of known competency as mechanics and who have the necessary knowledge of welding theory to meet the problems involved in the shop where training is being given. Other selective factors might be those which would apply in choosing a worker for advancement to a foreman's position.

The Training Program

The Code of Minimum Requirements is the first serious attempt at standardizing practices in school training. Many privately operated schools go beyond it as do some of the public institutions. In-service training by manufacturers usually depends upon the particular requirements of production and the extent to which it is desired to develop skill and range of ability. It is possible to state only in a general way what would be the average ability of all students trained by different schools and plants but it appears that in practice it approximates the following. Students are trained to make welds in at least three of the four recognized positions: flat, overhead, vertical and horizontal. They learn to make bead welds, single-pass fillet welds, multiple-pass fillet welds and may be instructed in making groove welds. Tests for contour, soundness of welds and the extent of fusion are important in determining student progress and they are often made to demonstrate to the student errors or good work observed by the instructor. The use of such tests allows students to work without immediate supervision and still receive informative criticism from the instructor.

Theory receives less general attention but the Code calls for instruction on the following topics: safety in welding; welding machines; welding processes and weld-

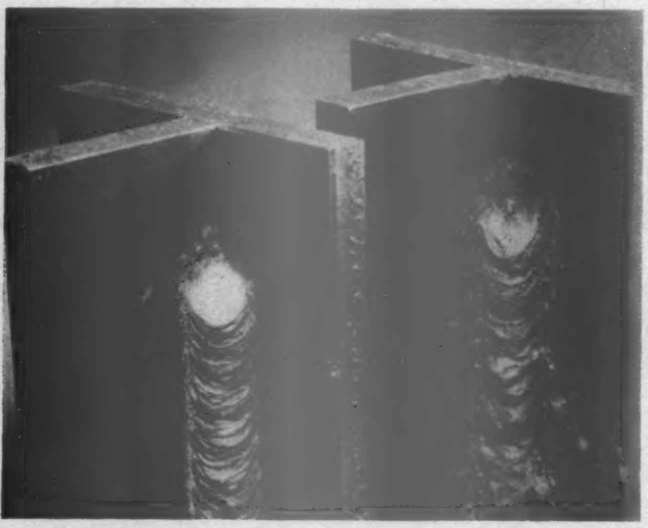


Individual attention for each student speeds learning

ing terms; weld gages and how to use them; characteristics of good welds; methods of testing welds; codes, standards and specifications relating to welding; inspection of welds; the nature of iron and steel, and types of electrodes and their uses.

Safety in Welding

The training of good welders requires that they must be thoroughly taught the rules of safe practice. In any



Proper welding current produced the vertical fillet weld on the left. Too high current on the weld on the right resulted in spatter and a rough surface condition

instruction course sufficient time should be allowed to impress on every student the necessity of observing these elementary rules:* (1) Wear proper shoes and clothing; (2) Use a helmet or shield having the proper protective glass when welding or in the vicinity of welding; (3) provide adequate ventilation on all jobs; (4) wear goggles when chipping or grinding; (5) remove all combustible materials from the vicinity of welding or cutting operations; (6) strike an arc only on the work to be welded; (7) avoid bodily contact with "live" electrical circuits; (8) prevent the electrode holder from becoming grounded; (9) observe that cable connections are tight and that cables do not become hot; (10) if using a gasoline-driven welding machine in a confined space make provision for venting the exhaust gases; (11) keep tools and equipment in their proper locations so that there is no possibility of stumbling over them; (12) be aware of the surroundings at all times and make no move until it is certain that it is safe; and (13) take proper precautions before welding or cutting containers which have, *or might have,* contained combustibles.†

Discussion of the proper training of welders in safe operating practices, covering both their own well being and the safety of others, indicates the extent to which other industries have concerned themselves with a problem which is always of primary importance. The other code headings listed are explanatory in themselves or serve to bring out the fields in which railroads might expand their training program, or they can serve as guides in the establishment of programs where none are now in operation.

* See Safe Practices Pamphlets No. 23 and No. 105, published by the National Safety Council, Inc., Chicago. Also, Health Protection in Welding, published by Metropolitan Life Insurance Co.

† See American Welding Society's Recommended Procedure to Be Followed in Preparing for Welding or Cutting Certain Types of Containers Which Have Held Combustibles.

Additional Helps in the Training Program

Most of the larger welding equipment and electrode manufacturers have published adequate instructions concerning the use of their products and some of them have available texts which can be used as basic or supplementary material in classrooms or shops. Service engineers are often able to offer helpful suggestions in the planning of a schedule which will give maximum results in the shortest possible time. Private sources, especially the American Welding Society, can furnish much material on welding practices although most of it is probably of too technical a nature for use in elementary welding training.

An important aid in supplementing class lectures, private study, actual demonstration, and student practice is the new series of colored motion picture films being distributed by the General Electric Company. First of their type in the field, these films, six in all, explain and emphasize the principal factors of good welding.

Although much that has been found useful in industrial training is also to be found in railroad welder-training programs, some of the roads have achieved excellent results under systems which they have developed to meet their particular needs.

Selection of Trainees A Railroad Problem

One of the great problems in railroad mechanical departments is selection of the men to be trained. Many roads have labor agreements which require the payment of differential rates to welders. These operate to allow senior men in roster standing to bid in the more highly paid jobs whether or not they are qualified as welding operators when they exercise their rights. Few roads recognize, or are permitted to treat, welding as a craft and maintain separate rosters of qualified welders.

The operation of seniority clauses in shops paying straight hourly rates often results in skilled mechanics bidding in welder's openings only to take advantage of the difference in pay rates. Since most of these men

Welders who took training on their own time to qualify for work on welded hopper car construction

are in the age group considered least adaptable to learning new skills, the net result is a loss of skilled craftsmen and the addition of at best only moderately competent welders.

In shops where piecework payments are in force, the payments to welders are usually for straight time plus

the welding differential. Since piecework income will usually exceed straight welder's pay, senior craftsmen prefer to retain their normal work and leave welding to younger men. This operates to the shop's advantage because the junior mechanics have received more welding training in their apprenticeship courses in recent years. They also qualify in most or all of the previously enumerated requirements for competent welding operators.

Where no added hourly payment is made to welders over the rate standard in the recognized crafts less difficulty is experienced in obtaining men for training who more nearly meet the selective tests of other industries. Here, although seniority rights are still recognized, the tendency is for older men of high roster standing to remain in their craft and continue to perform duties they know well. Lacking financial incentive, applicants for training will be those who have a real interest in welding and the desire to learn.

It is not evident that welding, as a craft, merits a wage premium over other shop occupations which require the completion of an apprenticeship or its equivalent. The problem of selection of the best type of trainees is certainly less where no differential is paid.

How Men Are Trained

Some welding instruction is included in most apprenticeship training courses today. Six months is a fairly common allocation of time in the usual four-year term and is proving adequate. In fact, it exceeds the ordinary period of training in most reputable private trade schools. The effort is to develop competency in both oxy-acetylene and electric arc processes and as apprentices complete their training, railroads are building up a reserve of men to whom welding is no mystery. Because of the limitations of many craft agreements most of these men cannot be used as welding operators. Other training programs must be devised to instruct men who desire training to qualify for differential rates.

In cases where the pay scale for welding attracts men

Close observance of the arc crater and arc action is necessary for good welding

from the tops of the rosters, it is customary to grant such applicants a specified period of time in which to qualify. Ninety days is a common trial period and during this time learning is done on the job. Without previous welding practice or experience such workmen are immediately assigned to production work. Progress in learning will vary with individuals but essentially this

Instruction in the care, operation and characteristics of welding machines is an important part of training

method of training is not greatly different than that followed in the earliest bare-electrode days.

During the trial period some applicants find their previous occupation more desirable and voluntarily return to it. Others who hang on for the time allowed for qualification fail to pass even the usually simple tests required and are returned to their former work. Of those who remain a few will eventually become good all-around welders. Most of the others will be satisfactory if their work is largely repetitive.

Labor-Management Cooperation in Training

On one railroad, which planned a car construction program in which welding was involved extensively, representatives of the carmen's organization approached the management with a proposal for preliminary training. Electric arc welding had not been used to any great extent and there were few qualified welders for freight-car work. The employees volunteered to learn welding in hours after the regular working day if the management would furnish facilities and supplies. Instructors were volunteers from among the skilled operators in the shop and they served without pay.

In this instance only minimum skill in horizontal and vertical and flat welding with all-position electrodes was needed and most of the men qualified without difficulty. Some, realizing that they would not like welding, dropped out of the training groups. Those who completed their training formed a substantial nucleus around which was built up the construction force.

It is interesting to note that all of the men who chose this form of training would have been entitled to bid in welder's vacancies and learn on the job when the construction program started. Instead they chose to anticipate the call for additional welders and qualify in advance. They made possible the full output of cars according to schedule from the date building was started. The management by this alone was repaid for the cost of materials used in the voluntary training classes.

Training Welders in Reserve

At every major shop and enginehouse on a railroad which does not pay a differential to welders a pool of trained operators is maintained to fill vacancies as they occur. When additional welders are required to maintain the pools at their pre-determined strength bulletins are posted advertising training opportunities. The responsible mechanical-department officers choose trainees from the applicants with seniority a determining factor in the selection. As previously explained, older mechanics do not often bid in these training opportunities.

If the chosen trainees pass a medical examination covering vision, hearing, lungs and heart, and have no hernia or history of dizzy spells, they enter the formal training period. This period covers a maximum of 21 days on paid time in regular class groups. No production is expected of trainees. Class members may submit their first test specimens on the twelfth day of training and must submit them on the fifteenth day. If they fail on the first test, a second qualifying test is given after three additional days of training; a final three days is allowed after a second failure. If test specimens submitted after 21 days are not satisfactory, the trainee returns to his regular craft roster standing.

Men who qualify are assigned to the pool at their point of service and are required to bid in the first bulletined welding jobs for which they are eligible. Failure to accept welding work when it is available results in the removal of a man's name from the welder's roster and bars bidding in the future. This does not prejudice a man's standing on his regular craft or helper's roster.

Qualifying Tests

Some roads depend entirely on observation by immediate supervisors or welding leaders or foremen to determine competency. Others require the welding of tensile test pieces, nick-break specimens, or both. Some have graded tests or require certain experience before advancing welders to the more difficult welding operations. In one instance it was found that monthly test pieces were demanded of all welders and closely checked by mechanical officers.

It has been found that periodic testing of the quality of welds serves, in some instances to keep welders from becoming lax where long familiarity with a particular type of work has a tendency to develop a false feeling of confidence in their ability. The importance of periodic testing is well recognized in the welded pressure-vessel industry and is of value in any field of welding.

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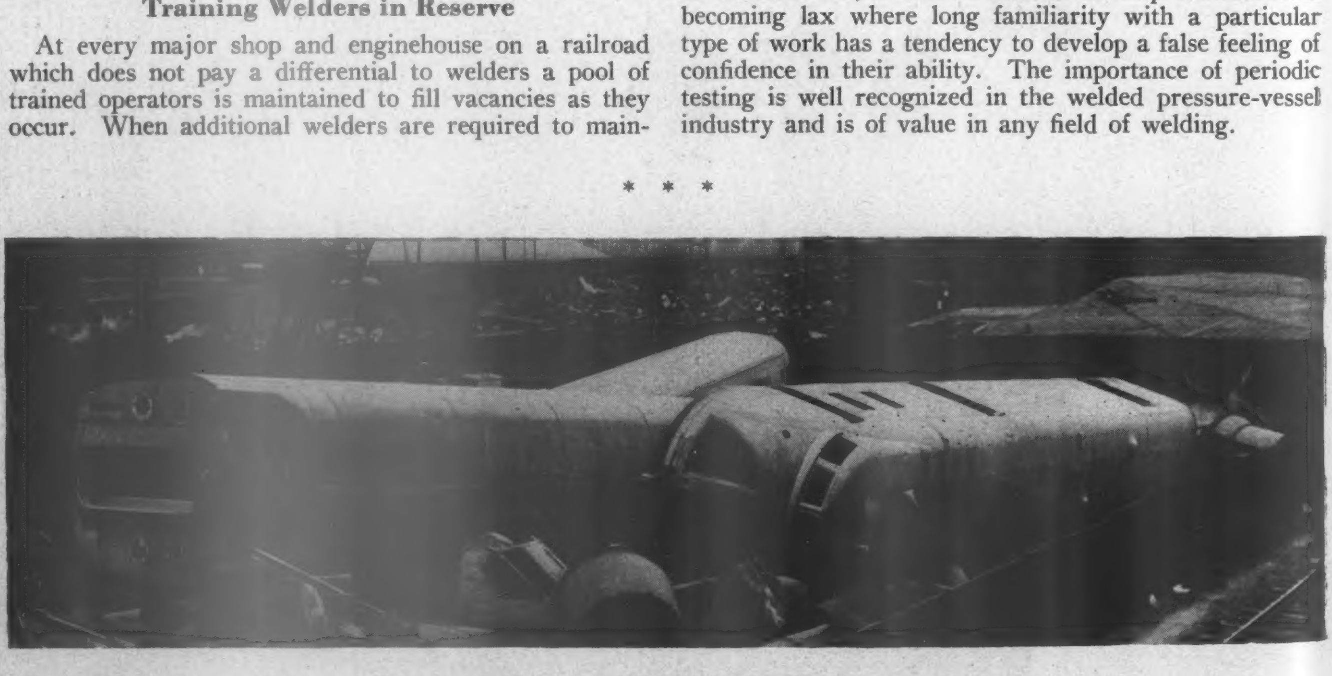


The "City of Salina" being dismantled at the Union Pacific yards

The M-10000, later named the "City of Salina," was the first high-speed streamline aluminum train. It was built by the Pullman-Standard Car Manufacturing Company and was delivered to the railroad in February, 1934. Although the power plant, a 600-hp. 12-cylinder distillate-burning engine, was worn out and obsolete, the train could have been continued in active service indefinitely so far as the structure of the cars was concerned. The train was of tubular cross-section, with the outer surfaces of aluminum sheets and framework built of extruded aluminum-alloy sections. It consisted of three articulated units, the forward unit containing the power plant, a 33-ft. mail compartment, and a small baggage room. The second unit was a 60-passenger coach, and the third unit, a 56-passenger coach with a buffet in the rear for serving light meals. The overall length of the train was 204 ft. 5 in. Scrapping the train made 64,000 lb. of aluminum available for war purposes.

What Do the Railroads Weld?

Repair, reclamation, fabrication and application — Railroads increasing range of welding interests — Methods are not uniform

Any tabulation of the jobs done by welding in the shops of railway mechanical departments is, at best, incomplete. Each day sees a greater extension of welding practices. With present material shortages and delays in deliveries mechanical officers are considering more and more parts of their equipment with reference to weldability. Structural parts and accessories are now being welded that would have been scrapped a few years ago because reclaiming or repairing by welding was more expensive than the purchase of new material. Today it is necessary to consider primarily the requirement of keeping motive power and rolling equipment in service; cost of welding is not being considered if it eliminates delays in releasing equipment. Many of the welding practices to which the railroads have gone will be continued after materials again become more freely available because they are proving economical as well as mechanically satisfactory.

The lists which appear on these pages were prepared after study of the welding manuals of eleven large railway systems, and shop visits and interviews with welding supervisors and foremen of several railroads. They are not published as being complete, it is even doubtful that they include all of the items being repaired, reclaimed or fabricated in the shops visited. Not all of the railroads studied perform all of the operations shown. Some which permit the building-up of worn surfaces on some pieces will not allow the welding of cracks and fractures on the same pieces; others permit both. Fabrication by welding and application of parts by welding are more extensively done on some roads than on others. Methods vary with the determinations of engineering departments, test engineers or shop welding committees; one railroad may specify oxy-acetylene welding with a preheat where another calls for electric-arc welding without preheat; still another makes the method to be followed optional. Shop equipment and the availability of skilled operators is often a determining factor here.

In general it may be said that, for all of the items listed, either the electricarc or the oxy-acetylene method may be followed. Procedural difficulties and cost make the choice of methods one to be studied with reference to each application.

Railroad shops are actually performing the operations indicated in the following lists or their welding manuals provide a procedure to be followed.

A List of Car and Locomotive Parts Which Are Repaired by Welding

Locomotive Parts	Type of Operation* 1	2	3	4	5
Air compressor	..	..	X	..	..
Air pump bottom head stops	..	X	..	..	..
Air pump center section	..	X	..	..	..
Air pump cylinder	..	..	X	..	..
Air pump valve seat	..	X	..	..	..
Ashpan	X	X	X	X	X
Ashpan angle	X	..	X	..	X
Ashpan axle guard	X	..	X	X	X
Ashpan damper	X	..	X	..	..
Ashpan damper crank	..	X	X	..	..
Ashpan damper crank support	X	X	X	..	..
Ashpan damper handle	X	..	X	..	..

* 1.—Welding holes. 2.—Building up worn surfaces. 3.—Welding of cracks and fractures. 4.—Fabrication entirely, or in part, by welding. 5.—Applied to locomotives or cars by welding.

Locomotive Parts	Type of Operation 1	2	3	4	5
Ashpan damper hinge	X	X	X	..	X
Ashpan dump lever	..	X	X	..	..
Ashpan hopper	..	X	X	X	..
Ashpan hopper slide guide	..	X	X	..	..
Ashpan support	..	X	X	..	..
Bell	..	X	X	..	..
Bell clapper	..	X	X	..	..
Bell stand	..	X	X	..	..
Bell stand seat	..	X	X	..	..
Bell yoke	..	X	X	..	..
Blowoff valve arm	X	X	X	..	..
Boiler, exception unstayed surfaces	X	X	X	X	X
Boiler bearing	..	X	X	..	..
Boiler bearing plate	..	X	X	..	X
Boiler bearing saddle	..	X	X	..	..

All-welded Southern valve gear support bracket

Locomotive Parts	1	2	3	4	5
Boiler brace	..	..	X	..	..
Booster engine crosshead	..	X	..	..	..
Booster engine crosshead guides	..	X	..	..	..
Booster engine cylinders	..	..	X	..	..
Booster engine piston heads	..	X	..	..	..
Booster engine throttle valves	..	X	..	..	..
Booster throttles	..	..	X	..	..
Brackets	X	X	X	X	X
Brake beam	..	X	..	..	..
Brake cylinder	..	X	X	..	..
Brake cylinder equalizer	..	X	..	..	..
Brake fulcrums	..	X	..	..	..
Brake hanger	..	..	..	X	..
Brake hanger bracket	..	X	..	..	..
Brake head	..	X	..	..	..
Brake lever	..	X	X	..	..
Brake pipe	..	X	X	..	X
Brake rod	..	X	..	..	..
Brake shaft bearing	..	X	..	..	..
Buffer casting	..	X	..	..	..
Bull ring	..	X	..	..	..
Bumpers	..	..	X	..	..
Bushing, on rods for grease plug	..	..	..	..	X
Cab	..	..	..	X	X
Cab gutter	..	..	X	X	X
Cab seat	..	..	X	X	X
Cab seat frame	X	..	X	X	X
Cab ventilator	X	X	X	X	X
Cab window slide	..	X	X	..	..
Cellars	..	X	..	..	..
Chafing iron	..	X	..	..	..
Copper-clad steel tubes in electric locomotive boilers	..	..	..	..	X
Counterbalance	..	..	..	X	..
Coupler bodies	..	X	..	..	..
Coupler horn	..	X	..	..	..
Coupler knuckles	..	X	..	..	..
Coupler locks	..	X	..	..	..
Coupler pocket	..	X	..	..	..
Coupler yokes	..	X	..	..	..
Cover plate tender trucks	..	X	..	..	..
Crossheads, except piston rod, keyway and wrist pin fits	..	X	X	X	..

Locomotive Parts	Type of Operation 1	2	3	4	5
Crosshead guide	..	X	..	..	..
Crossties	..	..	X	..	..
Cylinder	..	X	X	X	..
Deck	..	X	X	..	..
Dome casing	..	X	X	X	..
Draft castings	..	X	..	..	..
Driver brake connecting rod	..	X	..	..	..
Driving wheel spoke	..	..	X	..	..
Drypipe	..	X	X	X	..
Dynamo bodies	..	..	X	..	..
Eccentric crank	..	X	X	..	..
Eccentric rod	X	X	..	..	..
Eccentric strap	..	X	..	..	..
Equalizer, if not in tension	..	X	..	..	..
Equalizer support bracket	..	X	X	..	..
Exhaust nozzle	..	X	X	X	..
Expansion pad	X	..	X	..	..
Expansion pad cap	..	X	..	..	..
Exhaust pipe	..	..	X	..	..
Feedwater heater	..	..	X	..	..
Feedwater pump bodies	..	..	X	..	..
Filler castings	..	..	X	..	..
Firebox ring	..	X	X	X	..
Firedoor	X	X	X	..	..
Firedoor catch	..	X	X	..	..
Firedoor cylinder head	..	X	..	..	..
Firedoor cylinder strap	..	X	..	..	..
Firedoor damper	..	X	X	..	..
Firedoor deflector	..	..	X	..	..
Firedoor foot pedal	..	X	..	..	..
Firedoor foot pedal connecting rod	..	X	..	..	..
Firedoor frame	..	X	X	X	X
Firedoor guide	..	X	X	..	..
Firedoor handle	..	..	X	..	..
Firedoor handle connecting rod	..	X	X	..	..
Firedoor hinge	..	X	X	..	..
Firedoor hinge bracket	..	X	X	..	..
Firedoor hood	..	X	X	X	..
Firedoor latch	X	X	X	..	..
Firedoor operating cylinder	..	..	X	..	..
Flange lubricator bodies	..	X	X	..	..
Flues	..	X	..	..	..
Flue sheets	..	..	..	..	X
Flue sheet bridge	..	..	X	..	..
Foot plate	..	..	X	..	..
Frame, locomotive and truck	X	X	X	X	X
Frame brace	..	X	X	X	X
Grates	..	X	..	..	..
Grate bearers	..	X	X	..	..
Grate connecting rod	..	X	X	..	..
Grate crank	..	X	X	..	..
Grate crank bracket	..	X	X	..	..
Grate end frame	..	X	X	..	..
Grate lever	..	X	X	..	..
Grate lever catch	..	X	X	..	..
Grate lever fulcrum	..	X	X	..	..
Grate lever hanger	..	X	X	..	..
Grate rocker trunnion	..	X	..	..	..
Grate shaft	..	X	..	..	..

Welding superheater tubes to sheet

Locomotive Parts	Type of Operation 1	2	3	4	5
Grate shaft bearing	..	X	X	..	..
Grate shaft bracket	..	X	X	..	..
Grate shaker	..	X	X	..	..
Guide yoke	..	X	X	X	..
Handrail bracket	..	X	..	..	..
Hub	..	X	X	..	..
Hub faces on truck boxes	..	X	..	..	..
Hub liners	..	..	..	..	X
Injector bracket	..	X	X	..	..
Injector connecting rods	..	X	X	..	..
Injector overflow pipe	..	X	X	..	..
Injector steampipe	..	X	X	..	..
Journal box lid	..	..	X	..	..
Journal box lid hinge	..	X	..	..	..
Lubricator	..	X	X	..	..
Motion work	..	..	..	X	..
Mud ring cross brace	X	X	X	..	..
Pedestal, locomotive	X	X	X	X	X
Pedestal binder	..	X	..	..	..
Pedestal crosstie	X	X	..	..	..
Pedestal jaw	..	X	..	..	..
Pedestal tie	..	X	..	..	..
Petticoat pipe	..	..	X	X	X
Pilot	X	X	X	X	X

Built-up crosshead wrist pin hole—Pipe braces hold crosshead open to correct size

Pipe	..	X	X	X	X
Piston	..	X	..	X	..
Piston heads	..	X	..	..	..
Piston valve and valve stem	..	X	..	..	..
Power reverse crank pin	..	X	X	..	..
Power reverse connecting rod	X	X	X	..	..
Power reverse crosshead and guide	X	X	X	..	..
Power reverse cylinder	..	..	X	..	..
Power reverse levers	X	X	..	..	..
Power reverse piston and valve	..	X	..	..	..
Power reverse piston follower	..	X	..	..	..
Power reverse rocker	..	X	..	..	..
Power reverse valve chest	..	X	X	..	..
Power reverse yoke	X	X	X	..	..
Pull rod	..	X	..	..	..
Radius bars	..	X	..	..	..
Reach rod	..	X	X	..	..
Rocker bearing	..	X	..	..	..
Safe ending boiler tubes and flues	..	..	..	X	..
Safe ending copper tubes in electric loco. heat. boilers	..	..	..	X	..
Safety chain lug	..	X	..	..	..
Sand box	..	..	X	X	..
Sand box arm	..	X	X	..	..
Sand box connection	..	X	X	..	X
Sand box cover	..	..	X	..	..
Sand box rod and handle	..	X	X	..	..

Cracked or wreck-damaged bed castings can be repaired by welding

Locomotive Parts	Type of Operation 1	2	3	4	5
Sand pipe	..	X	X	..	X
Slack adjuster clevis	..	X	..	..	..
Smokebox	..	X	X	..	..
Smokebox door	..	..	X	..	..
Smokestack	X	X	X	X	X
Snow plow	..	..	..	X	..
Speed recorder wheels	..	X	..	..	..
Spring hanger seat	..	X	..	..	..
Spring hanger wear plates	..	..	..	..	X
Spring seat	..	X	X	..	..
Staybolt sleeve	..	..	..	..	X
Steam chest	..	..	X	..	..
Steam chest bushing	..	X	..	..	..
Steam chest cover and casing	..	..	X	..	..
Stoker cradle casting	..	X	X	..	..
Stoker cylinders	..	..	X	..	..
Stoker drives	..	X	X	..	..
Stoker elevator casings	X	X	X	..	..
Stoker elevator shaft bearings	..	X	X	..	..
Stoker engine cylinder head	..	X	X	..	..
Stoker engine frame	X	X	X	..	..
Stoker engine brackets	X	X	X	X	X
Stoker operating handles	X	X	X	..	..
Stoker rack housing	..	X	X	..	..
Stoker reach rods	..	X	X	..	..
Stoker screws	..	X	..	..	..
Superheater return bends	..	X	..	X	X
Superheater tube	..	X	X	..	..
Throttle lever	..	X	..	..	..
Throttle lever latch handle	..	X	..	..	..
Throttle lever latch link or connection	X	X	X	..	..
Throttle lever quadrant	..	X	..	..	..
Throttle rod	..	X	..	..	..
Throttle stuffing box	..	X	X	..	..
Throttle valve and stem	..	X	..	..	..
Throttle valve case	..	X	X	..	..
Train control receiver housing	..	X	..	..	..
Transom or chafing plate	..	X	..	..	..
Truck centering device	..	X	..	..	..
Truck equalizer	..	X	..	..	..
Truck side frame	..	X	X	..	..
Tube	..	X	..	..	..
Turbine	..	X	X	..	..
Valve gear crossheads	..	X	..	..	..
Valve gear frame bracket	..	X	X	..	..
Valve gear frames	..	X	X	X	..
Valve gear links	..	X	..	..	..
Valve gear link blocks	..	X	..	..	..
Valve handles	..	X	X	..	..
Valve rod	X	X	..	..	..
Washout plug	..	X	..	..	..
Wheel center, except hubs	..	X	X	X	X
Whistle crank	X	..	..	..	..
Whistle lever	X	..	..	..	..
Whistle lever rod	..	X	X	..	..

Car Parts	Type of Operation 1	2	3	4	5
Air brake hose coupling	..	X	..	..	..
Air compressor control cabinets	..	..	..	X	..
Armature shafts	..	X	..	..	..
Axle collar	..	X	..	..	..
Baggage car doors	..	..	..	X	..
Baggage car ends	..	X	..	X	..
Baggage car lockers	..	..	..	X	..
Baggage rack	..	..	X	X	..
Battery box	..	..	X	X	X
Battery box supports	..	..	X	X	X
Bell crank	..	X	..	..	..
Body bolster	..	..	..	X	..
Body bolster cover plates	X	X	X	..	..
Body bolster stiffeners	..	..	X	..	X
Body bolster web plate	..	..	X	..	X
Body brace	..	..	X	..	..
Body center plate	X	X	X	..	..
Body cross tie	X	X	X	..	..
Body side bearing	X	X	X	X	X
Bolster center casting	..	X	..	..	..
Bolster guides	..	..	..	X	..
Bottom rod guard or emergency support	..	X	..	..	X
Brace	..	..	X	..	X
Brake beam	..	X	..	..	..
Brake beam support	X	X	X	X	X
Brake cylinder	..	..	X	..	..
Brake cylinder back head	..	X	X	..	..
Brake cylinder crosshead	..	X	X	..	..
Brake cylinder lever connection	..	X	..	..	..
Brake cylinder tie rod	..	X	..	..	..
Brake cylinder tie rod anchor	..	X	..	..	..
Brake hanger	..	X	..	..	..
Brake hanger bracket or carrier	X	X	..	..	..
Brake head	..	X	..	..	..
Brake head guide, passenger	..	..	..	X	..
Brake lever	X	X	..	..	..
Brake lever bracket	X	X	..	..	..
Brake lever fulcrum	X	X	X	..	..
Brake pipe	..	..	..	X	X
Brake shaft bracket	X	X	X	..	X
Branch pipe tee support	..	..	X	..	X
Brine tanks, refrigerator cars	..	..	..	X	..
Buffer	..	X	..	..	..
Buffer plate	..	..	..	X	..
Buffer spring bracket	..	..	X	X	X
Caboose car steps	..	..	..	X	..
Caboose splash plates	..	..	..	..	X
Caboose stoves	..	..	X	..	..
Carline	..	..	X	..	X
Center plate	..	X	X	..	..
Center plate reinforcement and rear draft gear lugs	..	..	..	X	..
Center sill	..	X	X	X	..
Center sill separators	..	..	X	X	X
Connecting rod, brake	..	..	..	X	..
Corner post	..	..	X	X	X
Coupler carrier	..	X	X	X	X
Coupler centering device	..	X	..	..	..
Coupler head	..	X	X	..	..
Coupler horn	..	X	X	..	..
Coupler knuckle	..	X	..	..	..
Coupler knuckle lock	..	X	..	..	..
Coupler knuckle pin	..	X	..	..	..
Coupler lock lifter	..	X	..	..	..
Coupler shank	..	X	..	..	..
Coupler yoke	..	X	X	..	..
Cover plate	..	..	X	..	X
Crossbearer	X	X	X	..	X
Crossbearer or crosstie cover plate	..	..	..	..	X
Dead lever fulcrum bracket	..	..	..	X	..
Dead lever guide	..	..	X	..	..
Diagonal braces	..	..	X	..	X
Diaphragm of a vestibule	X	X	X	X	..
Door clasp	..	X	..	..	..
Door hasp holder	..	..	X	..	..
Door hasp staple	..	..	..	..	X
Door pin chain	..	..	..	..	X
Door threshold plate	..	..	X	..	..
Door track	..	..	X	X	X
Door track bracket	..	..	X	X	X
Draft casting	X	X	X	..	..
Draft gear pocket	..	..	..	X	..
Draft lugs	..	..	X	X	X
End door frames, freight	..	..	X	X	X
End plate	..	..	X	..	X
End post and end sill	X	..	X	..	X
End sheet	..	..	X	..	X
End top angle	X	..	X	..	X
Equalizer	..	X	..	..	..
Equalizer guide, passenger	..	..	..	X	..
Equalizer spring seat	..	..	..	X	..
Flexible gear centers, passenger	..	..	..	X	..
Floating lever bracket	X	X	X	X	X
Floating lever connection	..	X	..	..	..
Floor beam	..	..	X	..	..
Floor plate	..	..	X	X	..
Followers	..	X	..	..	..
Garbage tubes, dining cars	..	..	..	X	..
Gusset plates	X	..	X	..	X
Hopper	..	..	X	..	..
Hopper door	X	X	X	X	X
Hopper door frame	X	X	X	X	X
Hopper door hinge	X	X	X	X	X
Hopper door locking pawl	..	X	..	..	..
Ice hatch, dining cars	..	..	..	X	..
Journal box and bearing wedge	..	X	X	..	..
Journal box bolts	..	X	..	..	..
Journal box lid	..	..	X	..	..
Journal box water deflecting strip	..	..	..	..	X
Knuckle	..	X	..	..	..
Marker bracket	..	..	X	X	X
Pedestal tie bar	..	X	X	..	..
Pipe, brake cylinder and auxiliary reservoir	..	..	..	..	X
Platform	..	..	..	X	X
Push-pole pocket	..	..	X	X	X
Reservoir support (Air brake)	..	..	X	X	X
Roof	..	..	..	X	X
Running-board bracket	..	..	..	..	X
Side-door frame (Freight)	..	..	X	X	X
Side plate and side post	..	..	X	..	X
Side rail and side sill	X	..	X	..	X
Side sheet	..	..	X	..	X
Side stake	..	..	X	X	X
Sink drains—Dining cars	..	..	..	X	X
Spring plank	X	X	X	..	..
Stall partitions, horse cars	..	..	..	X	..
Striking plate	..	..	..	X	..

All-welded locomotive cab

Car Parts	Type of Operation 1	2	3	4	5
Swing hanger	X	X	..	..	..
Tables bases, dining cars	..	..	..	X	..
Transom	..	X	X	..	..
Truck bolster	..	X	X	..	..
Truck lever connection	..	X	..	..	..
Truck side bearing	X	X	X	X	X
Truck side frame	..	X	X	..	..
Winding shaft	..	X	X	..	..
Winding shaft rachet wheel and pawl	..	X	..	..	..
Window casing	X	..	X	X	X
Window frame	X	..	X	X	X
Window post	X	..	X	X	X
Yokes	..	X	..	..	..

Can It Be Welded?

Certain limitations on welding have been established by the Interstate Commerce Commission and by the A. A. R.—Individual railroads have added their own

After fusion welding was introduced as a tool for car and locomotive repair work its use extended rapidly. It provided a simple, cheap and easily applied means of reclaiming and restoring worn-out material, and repairing failed or partially-failed parts, in many cases without removing them from the car or locomotive. Inevitably the question of safety was bound to arise.

At the 1915 convention of the Master Car Builders' Association, as a result of a discussion of the hazards arising from the welding of arch bars, a general study of the need for limitations on the use of welding was inaugurated which culminated in a committee report presented at the 1919 meeting of Section III Mechanical, of the A. A. R. This report recommended a list of car parts on which the welding of cracks should not be permitted; a list of worn car parts on which building-up should be permitted; and a list of car parts on which welding of fractures should be permitted.

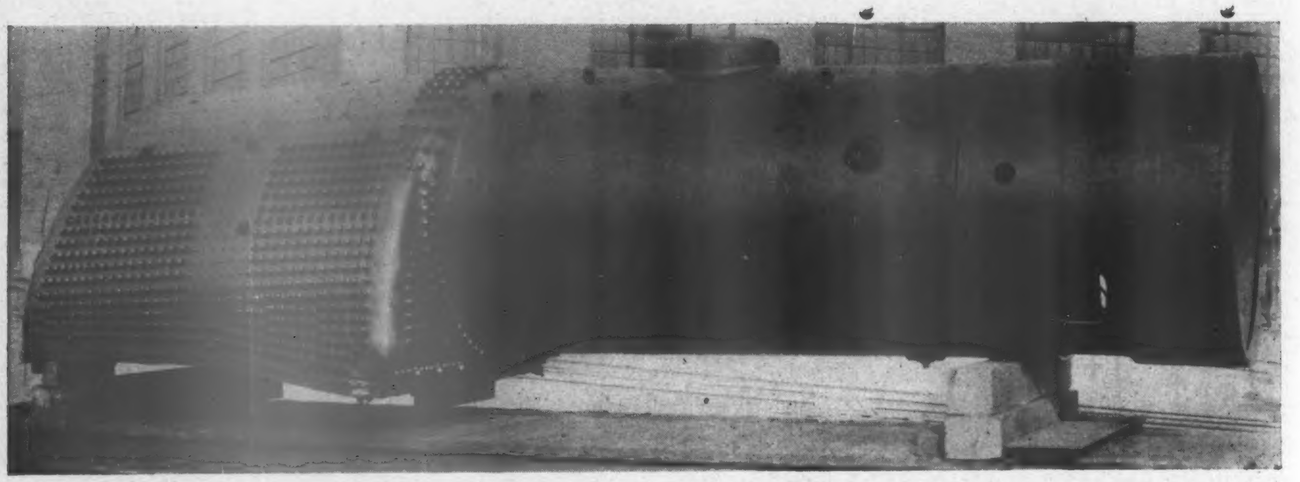
The recommendations made were adopted as recommended practice and, with relatively few changes, are embodied in Interchange Rule No. 23 today. Although this rule applies only to cars in interchange, the same principles are generally observed by most roads in relation to their locomotive maintenance. Briefly stated the principles are: Welding should not be permitted on parts subjected to high tensile stress, nor on parts made of alloy steel, or heat treated carbon steel. Exception of some parts, either partially or wholly subjected to tensile stresses, are made to the prohibitions against welding, provided the unimpaired material is not less than a specified percentage of the full-section area.

The Bureau of Locomotive Inspection and the Bureau of Safety of the Interstate Commerce Commission have established standards to be followed by all railroads and in their rulings have indicated the parts of cars and locomotives on which welding will not be permitted. Main and side rods may not be welded, and unstayed boiler surfaces may not be subjected to fusion welding heat. Welding on safety appliances is prohibited.

Railroad shop practice has developed a list of car and locomotive parts on which one or more railroads prohibit welding although there may be other roads which permit such welding. These items are shown in the list together with those which are prohibited by law or the A. A. R. Rules of Interchange.

Locomotive and Car Parts on Which Welding of Cracks and Fractures Is Not Permitted

Air reservoirs
Alloy steels
Axles
Bolster hangers
Brake beam hangers
Brake beam tension and compression members
Brake heads; malleable iron
Brake levers
Brake pullrods
Brake staffs
Brake wheels
Chains
Coupler heads
Coupler knuckles
Coupler knuckle pins
Coupler locks
Coupler lock lifters
Coupler lock throwers
Coupler yokes; wrought iron; cast steel, some exceptions
Crank pins
Crossheads at neck or wrist pin holes
Diesel engine connecting rods
Diesel engine crank shafts
Diesel rotating system members is highly stressed
Drawbars
Drawbar pins
Eccentric blades, cranks and rods
Equalizers; cast steel tender truck; driving wheel; engine truck; trailing wheel and passenger truck
Heat-treated carbon steel
Hubs of wheel centers
Injector bodies
Journal boxes
Main rods; except grease cup bushings
Piston rods
Reverse levers
Safety appliances
Side rods; except grease cup bushings
Spring hangers
Steam turrets
Superheater headers
Tanks of tank cars
Tires
Top chord angles if more than five feet from body bolster
Truck tie bars
Uncoupling levers
Unstayed boiler surfaces
Valve crossheads
Valve gear radius bar
Valve rods
Valve stems
Water columns
Wheels
Worn parts; beyond established wear limits



The Delaware & Hudson welded boiler will complete five years' service next September

What About

The All-Welded Boiler?

As the Delaware & Hudson boiler approaches the end of its five-year trial the Bureau of Locomotive Inspection grants provisional approval for other welded boilers — Construction held up by War Production Program—Promise of trouble-free service very attractive

During the early years of fusion welding in railway shops its use expanded at a tremendous rate. Indeed, it was soon looked upon as a cure-all for the ills resulting from wear and weakness or failure of parts. Its great attraction lay in the ability to restore or patch many worn or failed parts in place, thus saving the out-of-service time and the labor cost of removal and replacement.

In boiler repairs it proved particularly useful in patching firebox sheets and was also used to weld up or patch cracked barrel sheets. In the former case, where the support of the sheets did not depend upon the weld, it was successful. But, the same cannot be said with respect to its application on barrel plates which are entirely self-supporting. The welds had to be made from the outside only and were not stress relieved; they were frequently followed by further failures of the sheets, either in or adjacent to the welds. Hence, all welding on unstayed surfaces, except seal welding supported by riveting, is now prohibited by the Bureau of Locomotive Inspection.

For a number of years the Bureau in its reports called repeated attention to the fact that where welds were involved in the overheated area of crown sheets which failed because of low water, the sheets usually separated by tearing along the weld. Now the established rule is to confine welding in firebox sheets below lines 14 in. below the highest point of the crown sheet. Exceptions are the seams by which the back head and the inside door sheet are attached to the side and crown sheets.

Welding Accepted in Stationary Field

Fusion welding is recognized as a satisfactory means of joining parts in stationary-boiler and other pressure-vessel construction. This recognition was gained, however, only after a long and painful struggle. Increasing employment of fusion welding in this field ultimately brought the matter to the attention of the American Society of Mechanical Engineers Boiler Code Committee. In 1918 the National Welding Council requested that it be allowed to join the Boiler Code Committee in a thorough study of this situation.

The latter committee, early in 1918, appointed a subcommittee on welding to draft rules for safe welding practice. Within a year the National Welding Council had merged with the new American Welding Society and in January, 1920, the Boiler Code Committee requested the new society to appoint a conference committee to participate in drafting a set of welding rules for boiler construction.

The two bodies represented a wide range of interests and opinions and years of hard work were put in by both before a code could be agreed upon. Finally, in 1925, the first edition of the Code for Unfired Pressure Vessels was brought out. This code, later extended to cover power boilers, and the accepted procedure for welding and for the qualification of welders evolved by the American Welding Society have contributed tremendously to the attainment of assured results in welded structures. Combined with the X-ray method of testing, which discloses the hidden conditions within the welds, the advantages of certainty now lie with weld-

ing rather than with riveting under accepted methods of inspection of riveted construction.

Early Railroad Interest

Within six years after the A. S. M. E. Boiler Code Committee had adopted its first welding code, the officers of the Delaware & Hudson and the American Locomotive Company began a joint study which culminated in a design for a conventional locomotive boiler of all-welded design. In 1935, the General Committee of the Mechanical Division, A. R. A., took up the subject and instructed the Committee on Locomotive Construction to consult the builders and conduct a preliminary investigation of a basis of procedure and of the scope of research and tests which should be undertaken. Learning of the progress of the joint D. & H. and American Locomotive Company project, the committee joined forces with those at work on it. When completed, the design of the D. & H. boiler was thoroughly reviewed and approved by the sub-committee of the Locomotive Construction Committee, by representatives of the three steam locomotive builders, and by a representative of the American Welding Society.

Permission was then granted by J. M. Hall, director of the Bureau of Locomotive Inspection, I. C. C., to build, subject to final approval of the design by the General Committee of the Mechanical Division, one boiler which was to be considered experimental until it had completed five years of service.

This boiler is designed to carry a working pressure of 225 lb. per sq. in. with a factor of safety of five. The boiler shell is conical in form, 88 in. outside diameter at the front and 94 in. outside diameter at the firebox end. The tube sheet is laid out for a Type A superheater, with 316 2-in. tubes and 46 5⅜-in. flues. The firebox is 114¼ in. wide by 131¹⁵⁄₁₆ in. long inside at the mud ring. The shell course is of 1¹⁄₁₆-in. special low-carbon steel plate. Both longitudinal and circumferential seams are double butt welds and are allowed an efficiency of 90 per cent. The throat sheet and top connection between the shell and firebox wrapper is a unit, of 1³⁄₁₆-in. plate. The firebox wrapper is ⅝ in. and the back head ⁹⁄₁₆ in. thick. The back-head flange is deep enough to bring the welded seam between two rows of staybolts. The front tube sheet is a disc welded against a ring which, in turn, is fillet welded to the boiler shell. Crow feet for braces are riveted to the boiler heads and shell.

The D. & H. Boiler Built in 1937

The boiler was built at the Dunkirk, N. Y. plant of the American Locomotive Company. Facilities were arranged so that all welding was down hand. The welded seams were all examined by X-ray. When the shell and outside firebox structure was completed, it was shipped to Chattanooga, Tenn., for stress relieving in a furnace which was gradually brought up 1,100 to 1,150 deg. F. and held at that temperature for 2¼ hours and then cooled down in the furnace. A careful check of the structure after stress relieving revealed no distortion whatever.

The boiler then went to Schenectady, N. Y., for the insertion of the inside firebox and tubes, which were seal welded in the back head. After completion, the welds were hammer tested at a hydrostatic pressure of one and one-half times working pressure and then the hydrostatic pressure run up to two times the working pressure.

This was in March, 1937. After the boiler was received by the D. & H., it was used as a stationary boiler for a period of six weeks for observation and check before mounting on locomotive No. 1219. It was finally released for road freight service on September 24, 1937.

At quarterly inspections during the first year the jacket and lagging were removed and the seams all examined under 225 lb. boiler pressure. At the first annual inspection, September 24, 1938, the examination took place under a hydrostatic pressure of 340 lb. During the second year it was inspected semi-annually, and during subsequent year, annually. At each of these inspections the hydrostatic test was made at 340 lb. pressure.

The final annual inspection prior to completion of the five-year experimental period will be made during August, 1942. At all preceding inspections examinations of the welded seams have failed to reveal a single simmer. Apparently the boiler is in the same condition as when it went into service. As of June 1, 1942, Locomotive No. 1219 has made about 264,000 miles since the all-welded boiler was installed.

Riveted-Boiler Troubles

Since the D. & H. all-welded boiler has been in service there has been a growing feeling among mechanical-department officers that welding, properly supervised and conducted according to approved codes, holds attractive possibilities for the elimination of difficulties which have been growing acute in boilers of riveted construction designed to carry high pressures. The use of alloy steels to bring the weight required with higher boiler pressures back within former limits has been accompanied by other difficulties. Cracking of shell-courses have been reported after a period of service so short as to make the cost of maintenance and loss of use of the locomotive a problem of serious proportions. The cold-working of the heavy plates, the sudden change in stiffness of section arising from the lapping of heavy plates or from the application of welt strips, and the heavy caulking required tend to produce either sudden changes in stress concentration or heavy initial local stresses.

The problem of caustic embrittlement to which so much attention has been paid during the past few years is also involved. As it is now understood, caustic embrittlement takes place only where highly stressed metal is subjected to high caustic concentration. Such concentration is believed to build up in joints or around rivets where there are minute leaks. It is at such points as these that damage from caustic embrittlement is most evident.

It would seem, therefore, according to the current theory, that the all-welded boiler eliminates two of these conditions: first, the experience with the D. & H. boiler indicates that welding, according to approved procedure, leaves no place for leaks, and, second, that it eliminates the principal causes of local stress concentrations. Furthermore, the reduction in weight effected by the absence of heavy overlaps and rivet heads in the double butt-weld construction goes far to offset the effect of the increase in plate thickness required by higher boiler pressures without resort to the higher tensile strength of alloy steels.

In discussing the question of safety, it must be remembered that for several years past all boiler explosions have been the result of crown-sheet failures caused by low water. No change in the method of fabrication or the structure of the boiler exterior can increase or decrease the number of these failures. Judged by the statistics of failures, therefore, an improvement in the safety of the boiler structure will not be of outstanding importance. That such an improvement may be expected to result from a more general application of welding,

however, seems more than probable. The welded boiler is surrounded by safeguards in the form of X-ray examination and rigid code requirements as to stress relieving and acceptance tests. Thus, it is freed from the possibilities for hidden defects which exist in the riveted boiler and has the advantage of more uniform stress distribution.

Present Status

The experience of the D. & H. with its welded boiler has been so satisfactory that application has been made to the Bureau of Locomotive Inspection for the approval of the construction of another all-welded boiler. This application has been approved by the Bureau subject only to the provision that the building of the boiler will not interfere with essential war production and that the design and construction conform in all respects to the provisions of the A. S. M. E. Boiler Construction Code. As the matter now stands, such interference seems likely to hold further procedure in abeyance until there has been a reduction in the demands of the war-production program.

The Chicago, Milwaukee, St. Paul & Pacific has also developed a design for a completely welded locomotive boiler which has been approved by the sub-committee of the Committee on Locomotive Design of the A. A. R. The construction of a boiler from this design has also been approved subject to the same provisions as those referred to in connection with the D. & H. For much the same reason procedure in this case is being held in abeyance.

In the meantime, the Boiler Code Committee of the A. S. M. E. has proposed the addition of a number of rules to Section III of the Boiler Construction Code, which deals with boilers of locomotives. These rules provide for the all welded construction of locomotive boilers. Essentially, they set forth the procedure and test requirements developed in the construction of the first D. & H. all-welded boiler. These proposed rules for welding boilers of locomotives have been published for criticism and approval.* Subject to modifications which may be suggested by the comments or criticisms received by the committee, they will ultimately be adopted and become a part of the Code.

There are several respects in which the provisions of these rules are more severe than those pertaining to locomotive boilers of riveted construction. In the first place, a factor of safety of five rather than of 4½ is required. The welded boiler must be subjected to a hydrostatic test two times the maximum allowable working pressure after a hammer test of the welds which is made while the boiler is under hydrostatic pressure one and one-half times the maximum allowable working pressure.

While the prospects for the immediate extension of welded boiler construction are not bright because of the critical shortages of material and production capacity, the progress thus far made will undoubtedly lead to an extension of the benefits to be derived from boilers of this type as soon as there is relief from the present essential war production program. The construction of such boilers, however, will have to be under rigid control to assure workmanship of high quality carried out according to established procedures. To permit the building of welded boilers under a condition making such control difficult or impossible would be courting failures which would be sure to jeopardize the future progress of the art.

* See *Mechanical Engineering* for May, 1942, page 399.

Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

Welding Coupler Yokes To Shanks

Q.—Could you suggest a method of welding that would keep the rivets in coupler yokes from working loose?

A.—Welding can and will keep coupler-yoke rivets from working loose. The junction of the coupler yoke and the shank is either chipped out or cut out with the torch deep enough to take a good bead of coated rod about ½ in. deep. The gouging nozzle works well for this job, also the ¼-in. size rod.

Plate and Angle Layout Table

Q.—Can you suggest a design for a layout table that can be fabricated by welding?

A.—The table shown in the accompanying illustration is used exclusively for fine laying-out work. The top is made from two pieces of 1 in. by 12 in. by 24 in. welded together to form a surface 24 in. square. This plate was

Layout table fabricated by welding

machined all over and the top divided, with a pointed tool, into 4 in. squares. A ¾-in. angle frame was bent and welded to hold this plate. Legs of 1-in. angle were welded to the frame at the corners and a brace made of ¼-in. plate welded to the legs. The table was shimmed and leveled and the ends of the legs leaded in position. The top was placed in the frame, made absolutely level and leaded to hold it securely.

Gas Cutting and Welding Practices

Production of oxygen for industrial uses increased to 7,181,479 million cubic feet in 1941, compared with the 1939 output of 4,561,968 cu. ft. This was a 57.4 per cent increase. With the increased demands of war industries, particularly shipbuilding, it is expected that the 1942 production must be very much greater than that in 1941. Limitations in plant facilities and inadequacy of the present supply of compressed-gas cylinders has imposed a burden upon the companies furnishing compressed gases which they are endeavoring to meet to the best of their abilities. To date there has been no shortage but the Air Reduction Sales Company, recognizing the necessity of using every possible method to insure adequate supplies to all consumers, has instituted a campaign through its own representatives and by publicity to get maximum utilization of all gases with the greatest economy in shop practices.

Oversize tips waste gas

A check in one shop disclosed that 25 per cent of the oxygen purchased was being wasted through an accumulation of "insignificant" losses. Many of the practices observed might have been disregarded in peacetime but can only be considered wasteful and subject to correction now. Some of the things in which correction is desired will appear trivial to men who, over a period of years, have become accustomed to the practices in normal shop operations.

It can be pointed out that the use of a No. 2 cutting tip instead of a No. 1 on ½-in. plate consumes 10 to 20 per cent more oxygen and 16 per cent more acetylene than is needed. All of this is waste.

Excessive Pressures

One of the most common causes of waste, especially by inexperienced operators, is the use of pressures higher than those recommended by the manufacturers. When greater speed in cutting is desired the answer lies in the use of high-speed tips which do not consume additional oxygen. Another factor which requires the use of higher pressures to do regular work is the use of unnecessarily long lengths of hose or hose of too small a diameter. In the first case excessive pressures must be used to overcome line drop, in the other it must be used to force through a sufficient volume of gases to do the necessary work. In addition to being wasteful excessive pressures are very likely to cause leaks in the hose lines and result in even greater losses.

Torches and Tips

It is an old rule, and one which many men will claim is closely observed in their shops, which requires that no torch shall be burning if it is not in use. Three minutes of burning time in each working hour wastes five per cent of the gas consumption if those three minutes are not spent in productive work. Five per cent of the 1941 oxygen consumption was 360 million cubic feet, 1,636,000 normal cylinders.

Hose

With the present critical shortage in materials made from rubber it is important that hose be made to last as long as possible. It must be prevented from mistreatment which will cause leaks, kept away from hot oxides and sparks, free of oil and grease, protected at truck crossings by bridging, and, when damaged, repaired by cutting out the defective portions and splicing with standard splicing nipples. Excess hose should be stored in a cool, dark place to retard deterioration.

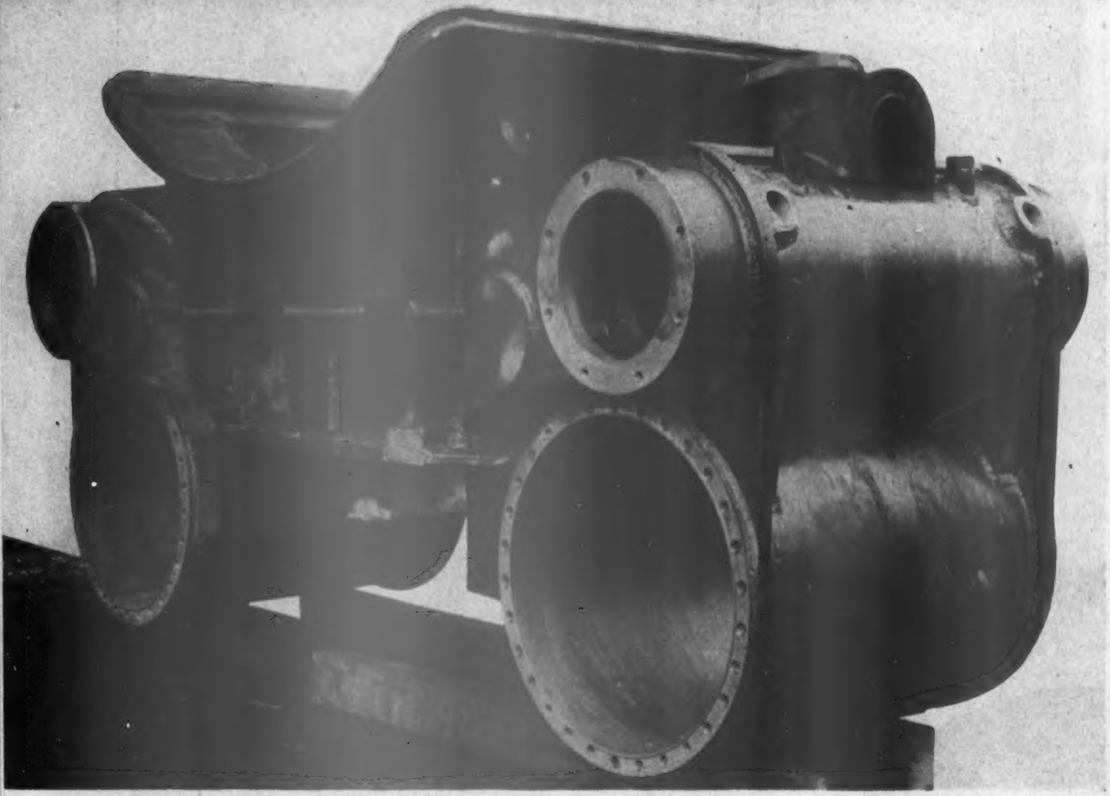
Cylinders

The present supply of compressed-gas cylinders is hardly sufficient for today's needs. Cylinders should be carefully handled to prevent damage, fully emptied, by manifolding if necessary, and returned to the manufacturer at the earliest possible moment. The maintenance of large reserve stocks is to be discouraged and greater dependence must be placed upon rapid turnover to keep all users currently supplied with their needs.

Maker-User Cooperation

This campaign is instituted by manufacturers of gases to insure the continuing supplies of their products to all industries which need them. It is expected that the campaign will be further extended by the issuance of shop posters, advertising and correspondence.

Use proper working pressures and close cylinder valves when finished



The steam locomotive cylinder offers one of the outstanding examples of the possibilities of fabrication by the welding process. To do this job required almost 200 separate pieces of steel of 50 shapes

Fabrication By Welding

THE recorded history of welding practice, particularly in the railroad shop, is not too clear on the point of just where and how the idea of building up parts entirely by welding originated but it is fairly safe to assume that the idea got its start as the result of a broken casting for which there was no pattern immediately available. Whatever may have been its origin the idea has spread rapidly until now, in the railroad field, fabricated welded structures, or weldments, range in size all the way from the smallest brackets up to massive parts such as cylinders for locomotives, underframes for locomotives and cars, locomotive cabs, car bodies and truck frames.

Welded structures have numerous advantages from the standpoint of strength and reduction in weight and, these days, when it is not always possible to secure castings, particularly large ones when they are required for emergency repairs, the welded structure solves the problem and keeps equipment in service that might otherwise be idle.

From the standpoint of the size of the part and complicity of structure the all-welded locomotive cylinder

In order to maintain alignment of parts and simplify the production of cylinders by welding a number of jigs and fixtures are required. The shop set-up for three cylinder-welding operations are shown in this photograph

Fabricated assemblies for freight and passenger car work offer an opportunity to speed up operations. A welding jig for a freight car bolster is shown here

In the photographs at the right and below are shown a welded fabricated driving wheel in the process of being assembled in the shop and the final result as it appears on the engine

Car and Locomotive Parts Fabricated by Welding

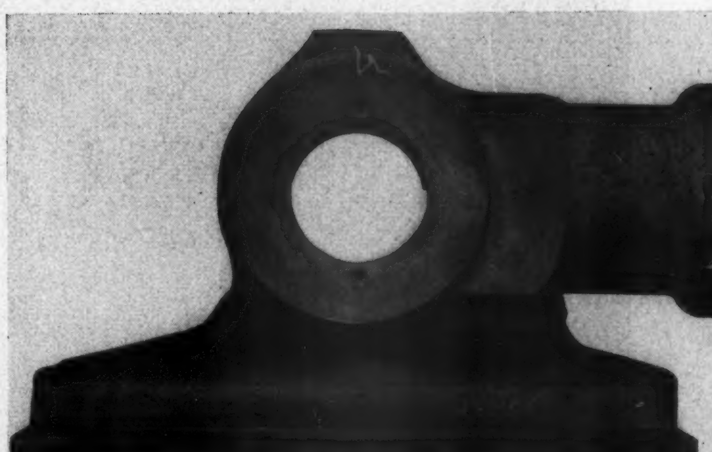
PASSENGER CAR PARTS:
- Face plate upper buffer spring bracket
- Truck equalizer guides
- Outside seat for semi-elliptical springs
- Outside brake head guides, on end rails
- Coupler stem supports
- Trucks, combined bolster guides, spring carrier and brake hanger, outside brackets
- Flexible gear centers for truck
- Roller bearing boxes and housings
- Draft gear pockets

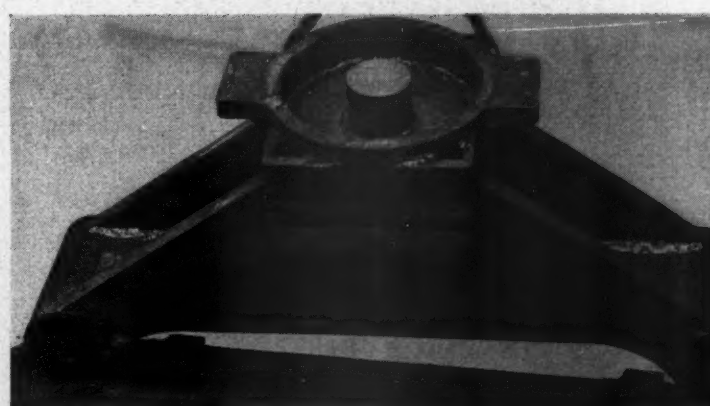
FREIGHT CAR PARTS:
- Center plate reinforcement and rear draft lugs
- Striking plates
- Coupler carriers
- Corner posts for drop-end gondola cars
- Bolster and crossbearer side stakes—gondola cars
- End door framing and side door posts—auto box cars
- Center sill separators
- Side bearings and braces
- Truck dead lever fulcrum bracket
- Body bolsters and hopper door frames for cement cars
- Truck frames
- Complete underframes
- Car roofs

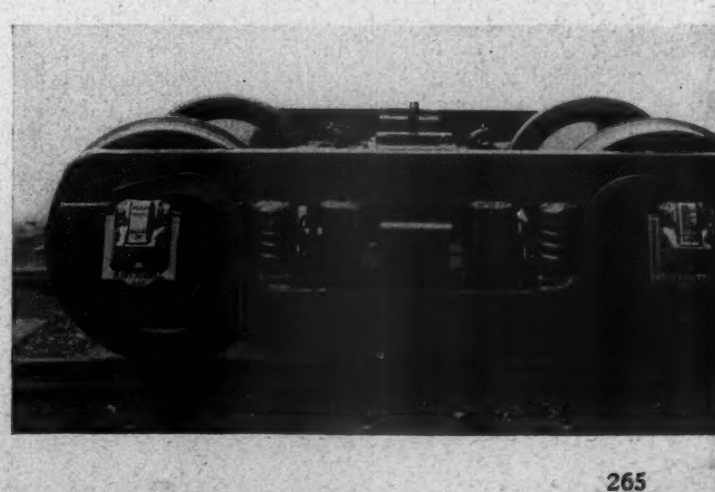
LOCOMOTIVE PARTS:
- Main steam cylinders
- Crossheads and pistons
- Driving wheel centers
- Guide yokes
- Driving spring stirrups and spring clips
- Main steam and exhaust pipes to cylinders
- Feedwater heater exhaust steam pipes
- Pilot with drop coupler
- Frame stiffening pieces
- Expansion plate attachment on main frames
- Front frame center piece
- Bracket for supporting stoker casting
- Boiler foundation ring
- Ash pan complete with hopper frames and doors
- Power reverse gear support brackets
- Lubricator support brackets
- Driver brake hanger
- Air compressor brackets
- Link and link shaft brackets
- Cab deck crosstie and support
- Blower motor support brackets
- Booster engine brackets
- Bolsters for electric locomotives
- Trailer truck roller caps
- Crank cases for gasoline rail car engines
- Tender truck center plates
- Coupler pocket extensions
- Chafing block extensions
- Smoke stacks and draft pipes

The list which appears on this page is but an indication of the many jobs in which fabrication by welding can play a part. Of the parts relating to locomotive valve gear there are several such as the bell crank in the top illustration that can be produced by this method. The photograph directly above shows what can be done in an emergency to return the gasoline engine of a rail car to service by fabricating a new crank case. The lower photograph is an ash pan

The entire locomotive frame or bed structure, one side rail of which is shown at the top of the page, is an example of the type of parts in which the welding process can be utilized to advantage to eliminate many of the connections that have always given trouble when bolted together. Of the three welded jobs shown at the right of the page the upper is a locomotive crosshead, the center a truck bolster and the lower a welded truck







takes a front rank in point of interest. Two of the illustrations accompanying this article show one of the completed cylinder sets and the jigs and fixtures on which they are made. The entire assembly, a pair of cylinders with saddles, ports and valve chambers, involves the use of almost 200 pieces of steel of over 50 different shapes, all of which are cut by means of the gas cutting machine. The barrels are rolled into shape and have single longitudinal seams.

Each complete cylinder requires over 1,200 linear feet of welding and the use of over a ton of welding wire. All of the parts of the cylinders are made of flange steel and after the welding is completed the entire assembly is stress-relieved for a period of about five hours. In the actual job of fabricating a structure as complicated as a cylinder there is a major problem of maintaining alignment and holding the finished assembly to dimension. This is accomplished by holding the work to extremely close tolerances and by making the proper allowances for contraction upon cooling of the welds. The saving in weight of these welded cylinders, as compared with the conventional cast cylinder, is in the neighborhood of 5,000 lb.

Another example of the welded structure of unusual size is that of a 90-ft. well car having a total weight of 314,000 lb. in which approximately two-thirds of the total weight is in welded assembly. The body of this car (described in the April 26, 1941, issue of Railway Age) was made up of seven H beams 18¾ in. deep and over 58 feet long. These massive beams were in turn built up of five separate members butt welded by the Thermit process. The individual beam members were built up by welding the top and bottom flanges to form the H beams and the seven completed individual beam members were then welded together at the edges of the flanges to form the continuous platform of the car. Some idea of the magnitude of this welding job can be gained from the fact that 8,000 lb. of thermit and 7,800 lb. of electrodes were used. There were over 38,000 linear feet of ¼-in. bead welding and 1,400 welding man-hours involved in this car job.

On these four pages are shown some typical examples of freight and passenger car and locomotive parts that have been fabricated by welding on a number of different railroads. In the table on page 264 there are a number of jobs of this type in addition to the examples shown in the photographs. This list is not by any means complete but it does contain such jobs as were actually reported by a number of roads in a limited survey.

Machine Gas Cutting

THE introduction of the oxyacetylene gas cutting machine into the railroad shop several years ago opened up a new field for the production of many locomotive and car parts in quantity. Some idea of the scope of usefulness of the cutting machine may be gained from the fact that lists compiled from many different railroad sources show that well over 300 different items used in railroad work many now be made wholly or in part by this method.

The size of parts that can be cut out may, for all practical purposes, be said to be limited only by the size of the table of the machine and the number of parts produced at a time bears a direct relation to the type of part and the number of cutting heads on the machine. Naturally, parts such as washers which may be cut from plate by the stack cutting method may, with a multiple-head machine be turned out in great quantity while a more complicated part, cut from a forged billet of 10 or 12 in. thickness will be limited in quantity. These examples are mentioned to show the wide range of possibilities in machine cutting.

Now that the fabrication of welded assemblies such as locomotive cylinders, air-compressor brackets, car-truck and body bolsters, cabs, driving wheels, crossheads, guide yokes, steam and exhaust pipes, pilots, etc., is progressing at such a rapid pace it is worth while pointing out that the facility with which this fabricated assembly work is done is not only greatly augmented but in many cases actually made possible by the use of the gas cutting machine. Two outstanding examples of this type of work are shown on these pages and reference to the article on fabrication by welding on page 262 of this issue will readily make plain to the reader the important part which the gas cutting machine now plays in this type of car and locomotive parts production by the welding method.

The accompanying illustration of the many parts that are necessary to make a single pair of welded locomotive steam cylinders shows what an important factor the cutting machine was in the job. In this group of almost 200 pieces there are over 50 different shapes and while it may not be entirely correct to say that they could not be produced by any other method it is safe to assume that the cost of so doing would be prohibitive.

Not the least of the cutting machine's advantages is

Some idea of the size of gas machine cut parts in railroad work may be gained from the illustration at the top of this page which shows several of the members of fabricated welded sills for a large well-type car. Where a variety of shapes of relatively small size are involved the group of parts for a welded locomotive cylinder on the opposite page shows the flexibility of the machine method. The third photograph shows washers being cut by machine

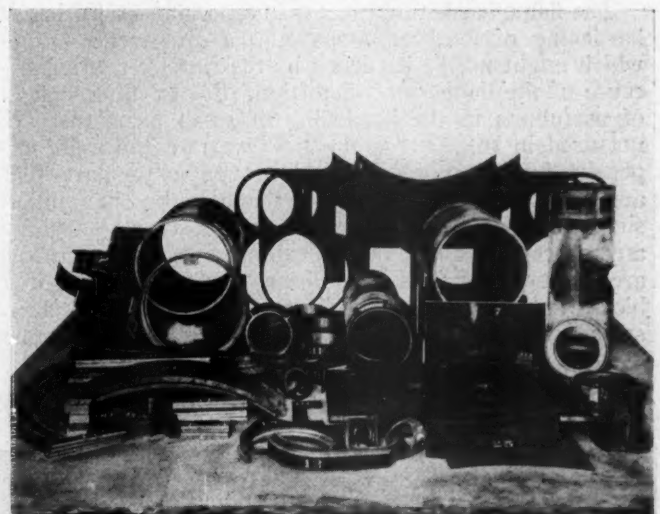
Typical Examples of Railroad Shape Cutting

Blow-off muffler
Boiler supports
Box car door track support
Buffer tread plates
Coal gate hinges
Crosshead bodies
Cylinder cock rigging
Cylinder head casings
Deck wind sheets
Diaphragm face plate
Draft gear pockets
Drawgear pin keeper
Driving boxes
Engine truck rocker bearings
Expansion plate liners
Firedoor pedal supports
Generator cable brackets
Grate shaker lever lock
Grate shaker rod shield
Handhole plates
Hub liners
Link motion parts
Locomotive frame sections
Main and side rods
Pipe flanges and clamp brackets
Reversing shafts and gear brackets
Runboard, sand box, and smokebox steps
Spring equalizers
Spring plank ends and ribs
Steam and air gage plates
Superheater header cover plate
Tank valve strainers
Tender brake retaining plate
Throttle lever and quadrant bracket
Truck pedestals
Valve rod support
Vestibule steps
Waist sheet frames
Waist sheet link support
Water scoop piston rod jaw

the ability to cut out parts to such close tolerances and with such smoothness as to surface that the part may be placed in service without any subsequent finishing by machining or otherwise. The degree of accuracy depends largely on the grade and thickness of the material and the intricacy of the shape. Where no finish is required ordinary steel plate may be cut right to the finish line. On high-carbon steels, where machining is to be done, only a finish tolerance need be left and this may be allowed for on the drawing or template.

The illustration at the head of this article shows machine-cut members for the underframe of a well car. This is an example of a relatively simple part of large size.

The accompanying table is far from complete; it includes many of the more important machine-cut parts.

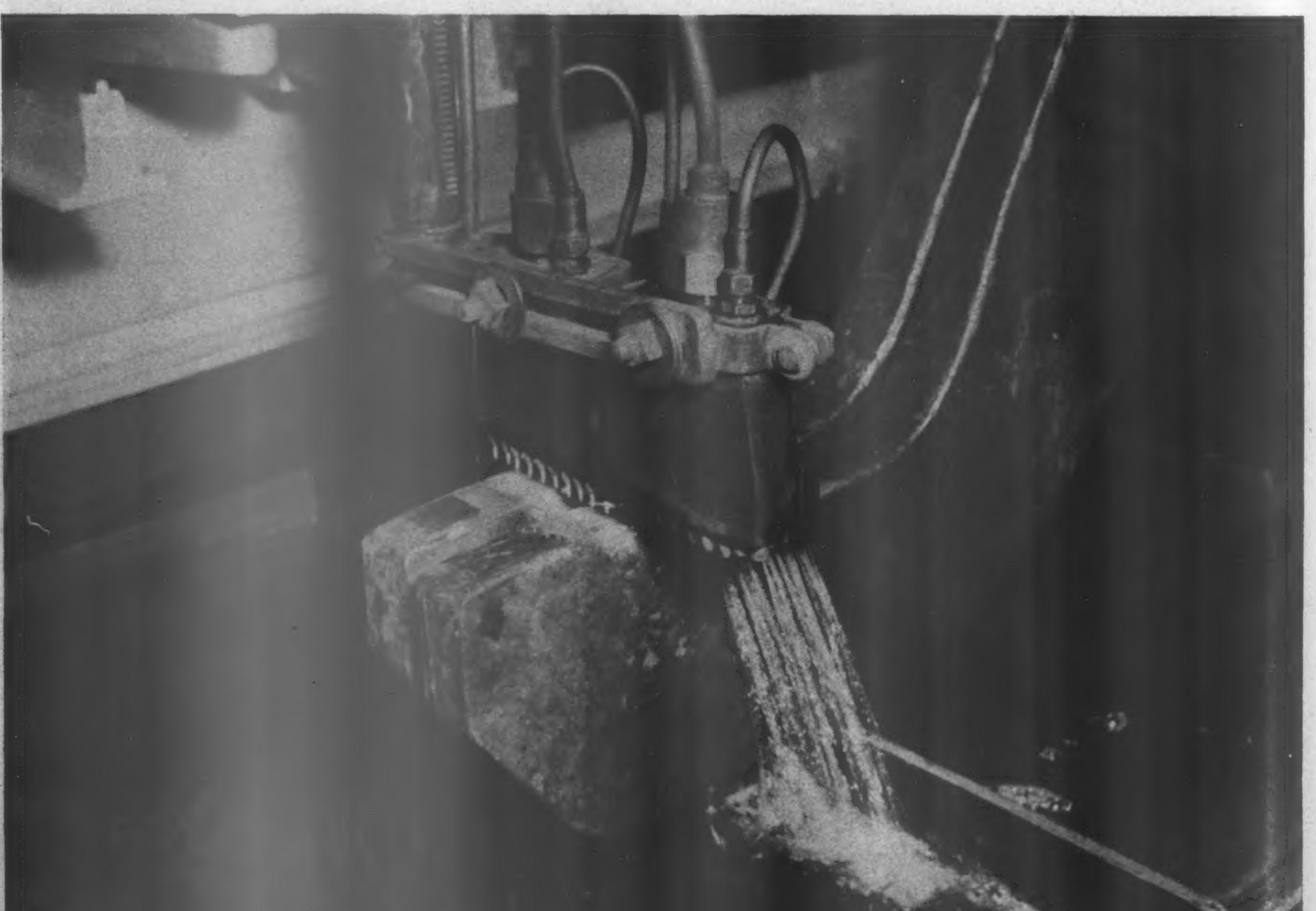


Flame Hardening

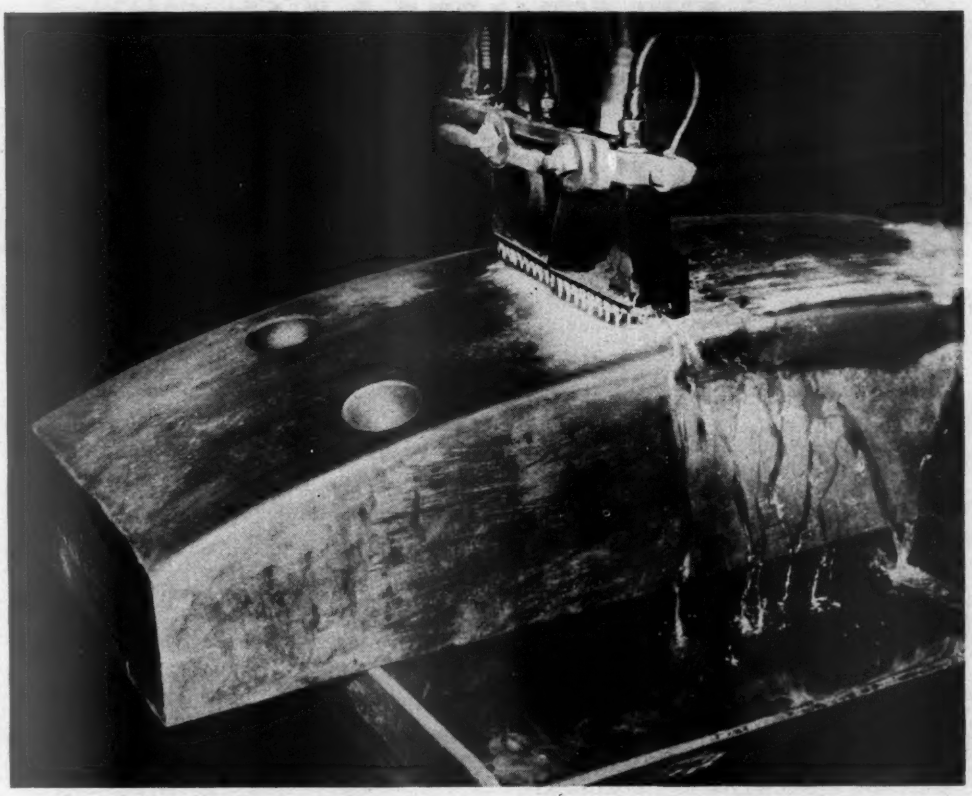
THE hardening of parts made of ferrous materials by the use of the oxyacetylene flame is not new in the railroad field for it was in the hardening of rail ends by this method that the first large-scale use of the process was initiated. This was about 15 years ago and since then the development of apparatus for industrial use has resulted in a steadily broadening scope of applications. As a result of this development the process is rapidly finding its way into the railroad shop for use in connection with a variety of car and locomotive parts.

The flame hardening process is especially useful in the hardening of localized areas on parts of large section which might not be hardened by the furnace method because of the dangers of distortion. It also finds a field of usefulness in the hardening of small parts that are not used in sufficient quantity to warrant the more expensive furnace process. A great many of the parts that are now being hardened by the flame method in railroad shops are parts that were not previously hardened by any process at all. Among examples of this character are locomotive guides, Walschaert motion links and link blocks, valve rod crossheads, truck box pedestal faces, spring saddles, frame shoes and wedges, tender chafing castings, stoker gears, stoker racks, stoker elevator screws, journal box equalizer seats, center buffer stems for passenger and baggage cars, truck equalizers, generator pulleys, journal box wedges, cast steel driving box cellars, cross spring equalizer bearings and brake shoe heads. The parts mentioned above give an excellent idea of the possibilities in the use of the process which can result not only in improved service from the parts in question but a materially longer service life.

While, as it has been pointed out, the majority of the applications in car and locomotive work have been of a nature that surface hardening by any practicable means was not possible prior to the introduction of the flame method there is the important factor of time. In other words, were it physically possible to harden some of the parts in question by another method the actual time required by the flame method is so short and the resultant cost so low that these factors alone open up a new field for its use in railroad work. Some idea of the time required may be gained from a few examples. Take the case of a Walschaert motion link where the surfaces in contact with the link block were hardened by the flame method. This case involved the hardening of



Flame hardening the ends of a pair of truck equalizers



The curved surface of a radial chafing block is an interesting hardening operation

Flame-Hardened Car and Locomotive Parts

	Brinell Hardness Before	Brinell Hardness After	Area Hardened Sq. in.	Oxygen used Cu. ft.	Acetylene used Cu. ft.
Buffer spring cap	275	550	31.5	9.3	9.3
Quill spring cap	300	550	17.5	5.3	5.3
Cab centering bracket	250	500	36.0	9.5	9.5
Buffer wearing pad	230	475	28.0	9.3	9.3
Cab bearer	250	600	8.9	6.2	6.2
Driving box cellar	180	400	19.5	3.0	3.0
Driving box wedge	180	450	172.1	53.1	53.1
Cross spring equalizer bearing	250	400	7.9	2.0	2.0
Brake beam head	230	400	4.5	1.7	1.7
Buffer center stem	300	600	8.9	2.4	2.4
Diesel frame rocker casting	210	250	55.8	19.0	19.0
Truck box—engine	217	450	175.0	26.0	26.0
Truck box—engine	170	350	23.0	5.0	5.0
Link block	250	500	39.0	8.0	8.0
Valve crosshead	217	550	92.0	14.0	14.0
Guide	197	550	709.4	198.0	198.0
Guide	217	500	744.3	218.0	218.0
Chafing casting (floating)	240	350	182.0	80.0	80.0
Chafing casting	250	350	162.0	50.0	50.0
Chafing casting—tender side	200	400	168.0	65.0	65.0
Spring saddle	217-255	429	44.0	12.0	12.0
Spring saddle	217-255	360-480	44.0	12.0	12.0
Spring saddle	180	450	35.8	13.8	13.8
Buffer stem	200	400	46.0	13.0	13.0
Center stem buffer block	200	400	30.0	9.0	9.0
Center buffer stem	270	450	10.0	3.0	3.0
Journal box	200	350	36.0	7.0	7.0
Crowned generator pulley	150	375	100.0	23.0	23.0
Journal box wedge	140	300	28.0	9.0	9.0
Journal box	180	300	36.0	7.0	7.0
Crowned generator pulley	150	300	84.0	19.0	19.0
Equalizer	200	450	33.0	6.0	6.0

144 sq. in. of surface and the actual hardening time was only 15 min. On the companion link block 38 sq. in. were hardened in 2 min. A valve rod crosshead required the hardening of 92 sq. in. and the hardening time was 5½ min. On a truck box the face and sides of the pedestal fit were hardened over a total area of 175 sq. in. and the hardening time was 11 min.

Locomotive Guides

Locomotive guides present an interesting example of the use of the process. In one case where the guides were made of axle steel a pair of guides 73 in. long were hardened for a distance of 57 in., on both the face and the side of the bar. Each of two guides required the hardening of 827 sq. in. of surface. This was accomplished by hardening the faces of the bars in a horizontal position and then the two guides were laid face to face and the sides hardened. In the case of long pieces such as these guides there is the problem of bowing and this is handled by heating the reverse side from the face to eliminate the bowing. The heating for hardening on these guides was at the rate of 6½ in. per minute and the straightening speed was 9 in. per min. The actual hardening time in this case was about 18 min. per guide.

The accompanying table shows a number of examples of car and locomotive work with hardening data.

EDITORIALS

Welding in Railroad Shops

Welding is an important tool of industry; some call it the most important present-day tool. While still in its infancy it was adopted by the railroad shops as an answer to many of the repair problems with which they were faced. More recently it has taken its place as an indispensable aid in the reclamation and repair of car and locomotive parts that would, in earlier years, have found their way to the scrap pile. Freight and passenger cars, streamlined and conventional, are now assembled as almost completely welded structures. An all-welded locomotive boiler has proved so successful in nearly five years of operation that permission has been granted for the construction of more of such boilers when the plant facilities of locomotive builders, now engaged in defense work together with their locomotive building, can be used for erecting them. Weldments are replacing built-up riveted structures and steel castings in the designing of new rolling stock and motive power. Welding's "future" has arrived on the railroads.

Restrictions Are Relatively Few

Railroad welding practices are restricted in part by rulings of the Interstate Commerce Commission and by Interchange Rule No. 23 of the Association of American Railroads. Trial and error methods in railroad shops have resulted in additional prohibitions against welding which vary widely from railroad to railroad. A list of such legal, interchange and railroad adopted prohibitions indicates that the restrictions on welding are not many when compared with the number of parts on which welding is permitted on both cars and locomotives. A good general picture of railroad welding can be obtained from a study of these lists in connection with the article contributed by an engineer of tests of a large railway system.

Most spectacular of the welding applications have been in the construction of many of the streamlined trains placed in operation in recent years. Far more interesting as an engineering development has been the service performance record of an all-welded locomotive boiler. A new field of locomotive design might conceivably result as new engines are built carrying welded boilers.

Shape Cutting and Flame Hardening

Shape-cutting has established itself as a needed auxiliary to welding in shops which are increasing the use of welded structures in car and locomotive maintenance and repair. By itself it is important in speeding many shop operations through the elimination of repetitive machine work. Stack cutting and the use of multiple heads on cutting operations are helping shops meet schedules.

Not yet widely used, but offering interesting possibilities, flame hardening of parts subjected to wear is being tried out by a number of railroads. Welding is commonly used for the building up of worn surfaces; flame-hardening, where it can be successfully applied, aims at diminishing wear and reduction of areas on parts which are subjected to chafing or other wearing movement.

Welding has grown on the railroads; it is proving its worth more and more in these times of material shortages and delayed deliveries. How well its growth has been guided is not readily apparent. Almost four hundred parts are known to be welded in railroad shops today. The list given can probably be extended by several more hundreds but it must be remembered that not all railroads perform all of the operations shown. Some of the jobs named are performed on only one of the eleven railroads studied; others are common practice on all.

Training Welders and Controlling Their Work

It is not clear whether managements and shop supervision are fully aware of the potentialities of this "tool" which has been in their shops for years. Wide variations in practice and the extent of its utilization are found on different roads. It would be dangerous and untrue to say that welding can be applied generally in maintenance and construction work. Applications should be made only after approval of competent, trained welding engineers or supervisors. Workmen too must be skillful; they must be familiar with the requirements of the completed job and with the technique of the best welding practices.

Welding operators cannot be made overnight as can riveters. An inspector's hammer will find the loose rivets in a job but a weld, unless too badly made, hides most of its defects within itself. Careful training and follow-up supervision is necessary in the development of qualified welding operators. Reluctance on the part of some to extend the range of welding applications in the railroad shops may be due to lack of understanding of the importance of having an adequate training program for operators. Failed welds should not be used as an argument against the use of welding if an operator was at fault. Established engineering and metallurgical principles will determine the nature of the parts which can be welded; only skilled operators can do a successful job.

Even Now A Choice Must Be Made

As this war takes shape it becomes apparent that shortages must inevitably develop with respect to many of the things we need. There are shortages of materials some of which are of a nature that can not, at the moment, be prevented. There are shortages of man power in industry that exist, in many cases, as a result of the lack of training programs in the skilled trades. In the railroad industry there are shortages of efficient facilities in shops and enginehouses because the lean earnings of the depression years didn't encourage modernization.

Inefficient facilities require the use of many manhours that can be saved by modern equipment. It is possible to secure many needed items, even under present conditions, and to continue to permit an obsolete machine or tool to waste valuable man-power when it can be prevented is something that can not be excused under any conditions.

Tapping Human Resourcefulness

Contributors to the contest on making the best possible use of mechanical-department equipment and facilities, reported in our April issue, had a good bit to say about the possibilities of larger co-operation from the workers through the use of suggestion systems. These are now used quite effectively by several railroads. It is interesting to note that these articles, which were written several months ago, dovetail to a degree with the suggestion made more recently by Donald M. Nelson, chairman of the War Production Board, that joint committees be set up in each industrial plant, composed of representatives of employees and management, to suggest ways and means for increasing production.

Railroad men were not slow to point out that much the same sort of plan has been in effect for many years in the form of labor union-management co-operation on the Baltimore & Ohio and the Canadian National. In the 18 years during which this system has functioned on the Baltimore & Ohio 11,673 meetings have been held. More than 32,000 suggestions were made, of which 27,715 were adopted; 326 are still under consideration, and 1,205 were deferred because the expense involved was too great to warrant their consideration up to this time. Less than 3,000—actually 2,914—were dropped because they were not considered practical.

On the Canadian National the first meeting in the mechanical department was held in January, 1925. During the intervening period 27,105 suggestions have been made, over 83 per cent of which have been accepted.

Other railroads have approached this problem from different angles, sometimes with notable success. In other instances it has not worked out so well, possibly because it has not been approached in the right sort of spirit, for, after all, human nature is extremely sensitive and can easily be discouraged if conditions are not what it is felt they should be.

Is it not true that the greatest possibilities for increased production and capacity under the existing emergency conditions depend upon releasing the latent potentialities in the human element? Ought not more critical study and consideration be given to the problem of dealing successfully with this factor? We speak of the advantages of thorough, scientific research in order to develop and utilize materials and equipment to the utmost. Ought not the same thought and consideration be given to problems of supervision and effective management? What is your answer?

These thoughts and these questions are inspired by a paragraph in a letter from an executive of one of our great railway systems. Here is what he had to say after he had read our April issue: "I was very much impressed with several points. For example, the hunger of men for recognition—a simple 'well done' upon completion of a job. One fellow mentioned that he never had had a pat on the back, and another said that in thirteen years he had never heard of but one being given! Their testimonies are tragic. I recommend that you do an editorial on them."

Will not the adoption of some sort of a formal cooperative or suggestion system go a long way to improve such conditions and release pent-up abilities and ingenuity to the mutual benefit of all concerned—the public, the workers, the managements and the stockholders? And above all, to the winning of the war?

Waste Is Dangerous

Railroad shop workers and supervisors have grown accustomed over a period of years to having available, when needed, sufficient supplies of oxygen and acetylene to meet all requirements. Some attempt has always been made to utilize these gases in the most efficient and economical manner but their very abundance has permitted the growth of slackness in the observance of the least wasteful operating practices. With the constantly increasing demands recently, and the prospect of a further increase—it may reach 900 per cent over 1941 demands in the shipbuilding industry—the productive facilities of all manufacturers, extended though they have been, are likely to prove too small unless every user cooperates in a determined effort not to waste a single cubic foot of oxygen or acetylene. At the present time the manufacturers are developing educational campaigns to teach conservation through proper utilization and efficient working practices.

Railroads use huge quantities of both oxygen and acetylene in normal equipment maintenance and build-

ing operations. Now their demands have increased along with the demands of other defense industries. Unless the users take measures to help themselves by eliminating waste there is a grave possibility that the demands of all American industry which is enlisted in the war will exceed the maximum oxygen and acetylene productive capacity. Railroads cannot afford to be rationed on these vital gases of production if they are to keep up with their equipment-repair programs.

Elsewhere in this issue will be found suggestions of some of the ways in which the user can help.

A Hot-Weather Method For Reducing Lost Time

The demand for increased output of repair work in railway locomotive and car shops, as well as in enginehouses, during the coming months, will necessitate attention to every condition which has a bearing on the productive capacity of shop forces already depleted by the loss of a number of experienced men to the military services. Labor-saving machinery and shop devices are of major importance, but the physical comfort of men engaged in exacting operations is by no means to be ignored as a factor in their operation.

Practice having a favorable effect on output, as demonstrated by experience in a number of railway shops, is to provide salt in one form or another at drinking fountains where it will be available for the use of shopmen engaged in heavy, hot work. Attention was first called to this matter in 1934 when 17 cases of death attributable to heat were reported among men engaged in the construction of Boulder Dam. Scientific investigations at Boulder Dam and subsequently in steel mills indicate that salt is both a preventive and a cure for heat cramps and moreover, when maintained in the proper proportion in the human body, prevents slowing up, excessive fatigue, loss of energy and efficiency; which are common symptoms of overheating. Experiments indicate that workmen ordinarily drink from one to two gallons of water a day, dependent upon how high the temperature is and how hard they work, and that about eight 10-gr. salt tablets, or one teaspoonful of table salt, is required for each gallon of water consumed, to maintain the salt balance necessary for normal functioning of the body.

In some railway shops, granulated table salt is provided at drinking fountains; another method is to supply it in the form of small tablets which can be kept in containers or dispensers at drinking fountains.

A recent limited survey showed that five out of six large raliway shops have been using salt in one form or another with satisfactory results over a period of years. One shop superintendent reports that it is provided at all shops on the system; another says its use is particularly helpful in preventing heat prostration of men employed in close, confined places or on hot work; still another typical comment is quoted as follows: "We have been supplying salt tablets to all of our employees at shops and in the stores department during the summer months since 1936. The results have been very satisfactory. Our records show that formerly we had a few instances of employees being overheated, but no such cases have occurred since we provided salt tablets during the hot weather when men perspire freely."

New Books

MOTION STUDY. *By Herbert C. Sampter, Ph. B. Published by the Pitman Publishing Company, New York. 152 pages, 7 in. by 8 in. Price, $1.75.*

Motion Study is intended as a simple, concise statement of the basic principles of motion study in a broad sense. It contains certain basic principles of how to work most effectively in analyzing any work in order to improve the method. Emphasis is placed upon the use of flow process charts in the application of motion study to processes as a whole, and upon the application of motion study to the planning of new jobs rather than merely to the improvement of existing jobs. The book has thirteen chapters on general and overall motion study and its application; working area; therbligs; laws and principles; micromotion study; safety and fatigue, etc.

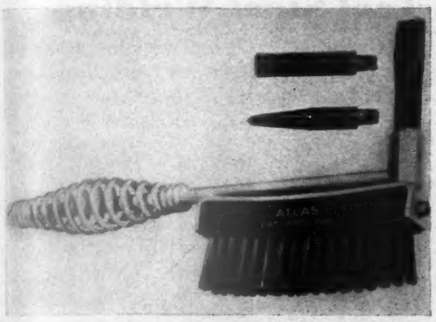
INDUSTRIAL SERIES. INDUSTRIAL SUPERVISION—ORGANIZATION; CONTROLS. *By Vernon G. Schaefer, Ph.D., and Willis Wissler, The Pennsylvania State College, and others. Price of each, $1.75.* SAFETY SUPERVISION. *By Vernon C. Schaefer. Price, $2.50. Published by the McGraw-Hill Book Company, Inc., New York. Each book 5 in by 7¼ in., bound in cloth.*

There are nine books in this series, each prepared under the direction of the Division of Engineering Extension, The Pennsylvania State College. Brief descriptions of the above three follow. *Industrial Supervision—Organization; Controls.* These books of ten chapters each are for the use of adult groups in industry and have been prepared to fill the needs of such groups while they are actively engaged in the work of industrial supervision. They are a thorough revision of all material at hand on the subject, including Foreman Training written in 1928 by George F. Mellen and revised in 1934 by Dr. Andrew Triche. New case studies are the contributions of industrial management, industrial psychology, and industrial economics. A shift in emphasis on supervisory training to the point where the problem of getting out production in the defense effort became paramount necessitated the present revisions. *Safety Supervision.*—A discussion in 14 chapters of the human element involved in the problems of the supervisor who must promote the safety of the workers in his division. The purpose of the book is to point out the necessity for, and some of the techniques in, good safety supervision, not to discuss engineering problems of safety or of conventional problems of making and keeping accident reports.

WELDING EQUIPMENT AND SUPPLIES

One Tool For Two Jobs

The Atlas Welding Accessories Company, Detroit, Mich., offers a combination tool with replaceable parts for weld cleaning. Ruggedly constructed, they combine a



Atlas weld cleaning tool with replaceable parts

cleaning chisel and wire brush to speed up weld cleaning and eliminate the necessity of a welder putting down his cleaning chisel to pick up a wire brush to complete the slag cleaning operation incident to the use of covered electrodes in multiple-pass welding. The purchaser has a choice of cone, chisel or blunt cleaning bits.

Coated Aluminum-Bronze Electrodes

Ampco Metal, Inc., Milwaukee, Wis., manufactures a line of coated aluminum bronze weldrods covering a wide range of strength and hardness. The table gives the physical properties which may be expected from the deposited weld metal of these electrodes.

There are many possible applications for the various types of these electrodes on railway equipment. The use of Ampco-Trode 10 makes it possible to arc weld, instead of gas weld, manganese bronze and other copper alloys containing zinc. For arc welding with Ampco-Trode 10, it is necessary only to preheat these metals to 400 deg. or 500 deg. F., and then follow usual arc-welding practice. The wide range of hardness available in the other types of electrodes makes it possible to select the bronze most suitable for any type of service.

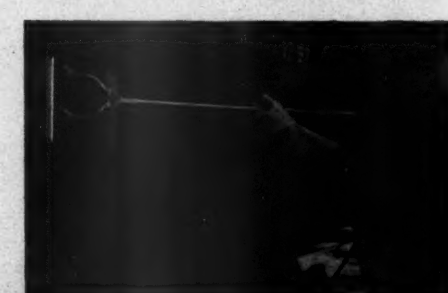
Physical Properties of Ampco Aluminum-Bronze Electrode

	Tensile strength, lb. per sq. in.	Yield strength, lb. per sq. in.	Elongation, per cent in 2 in.	Brinell hardness 3,000 KG-10 mm. Ball
Ampco-Trode 10	60-70,000	25-32,000	25-30	115-131
Ampco-Trode 12	65-75,000	25-29,000	22-27	109-124
Ampco-Trode 16	70-80,000	32-37,000	18-22	131-156
Ampco-Trode 18	77-85,000	34-40,000	10-14	159-183
Ampco-Trode 20	83-90,000	38-43,000	2-6	212-248
Ampco-Trode 21	70-80,000	42,000 min.	1-4	285-311
Ampco-Trode 22	70-85,000	45,000 min.	0-2	321-352

Flame Cleaning Before Painting

Flame cleaning and dehydrating of railroad equipment and cars is gaining in use through the recent introduction of a series of flame-cleaning heads and attachments by the Oxweld Railroad Service Company, Chicago, a unit of Union Carbide and Carbon Corporation. This oxyacetylene process, which is used before painting, removes loose paint, scale, and rust from steel surfaces, and at the same time drives out surface moisture so that the paint spreads more quickly and evenly and adheres more firmly. The use of flame cleaning helps in eliminating the major causes of subsequent corrosion and paint flaking.

Flame-cleaning heads are supplied in three widths: 2 in, 4 in. and 8 in. The 2-in. and 4-in. heads are used for general flame-cleaning operations and for close-quarter applications on underframes, equalizers and other small section members. The 8-in. head is specially designed for use on coach and car sides and similar surfaces where speed in cleaning large areas is desirable.



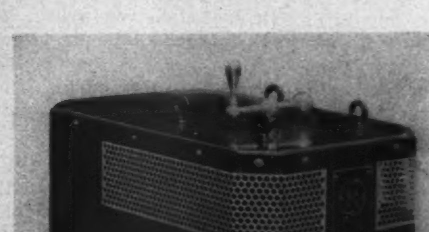
Oxy-acetylene flame-cleaning of a hopper-car side before applying paint

Construction of the heads is designed to give an even, neutral flame of high velocity from each orifice to provide uniform heating of the surface to be cleaned. Skids on each end of the head keep the flames positioned the correct distance from the surface of the metal. Mixer-tube assemblies of various capacities are used with the heads on standard welding blowpipes, and the length of the flame-cleaning equipment can be increased by means of extension tubes of from 6 in. to 20 in. The flame can thus be applied effectively from a height of about 8 ft. down to the ground or scaffold level with complete ease.

Atomic-Hydrogen Arc Welders

Atomic-hydrogen welders, manufactured by the General Electric Company, Schenectady, New York, are finding increasing use in industry for repairing tools and dies; for filling in flaws or blow-holes in steel and bronze castings; and for the fabrication and repair of hard-to-weld metals. The welders are compact and self-contained to reduce space requirements and to add to their portability.

Instead of the transformer and reactor used in previous units, the new welder has a specially designed reactive transformer which combines the functions of both the transformer and reactor. As a result, the weight of the welder has been reduced more than 30 per cent, and electrical char-



G-E atomic hydrogen arc-welding transformer

acteristics improved. Built-in power-factor correction in these welders helps to reduce installation cost and avoid power-factor penalties. Forced ventilation provides cool operation, even at high currents or on high-duty cycles.

Multiple Units for Production Welding

Applying the air compressor multiple idea to quantity arc welding, Electric Arc, Inc., Newark, N. J., is producing multiple alter-

Double 300-amp. multiple star unit with d.c. pilot arc

nating-current welding units which provide service to more welders for the amperage rating of the machines than could be obtained through the use of individual installations. Each unit attached to the machine draws only the amount of power for which it is set to make a given weld. It is said that increased speed with arc blow eliminated is possible and that the use of heavier currents and larger electrodes will reduce the cost per pound of deposited weld metal.

With this system, a transformer with capacity to furnish the greatest demand for welding power is located outside the working space out of the way of workmen and equipment. This eliminates any danger from high-voltage cables lying on the working floor. A system of leads on the shop wall with outlets available at working points enables an operator, by the use of simple controls, to regulate both voltage and current to fit the needs of his job. Each station is independent of all others.

Amsco Saves Nickel

Cooperating in the national effort to conserve nickel wherever it is possible the American Manganese Steel Division of the American Brake Shoe & Foundry Co., New York, has developed an electrode for use in repairing fractures in manganese-steel parts which were formerly welded with nickel-manganese rods. It is said that the new alloy rod contains manganese and molybdenum with quantities of other elements and that it is satisfactory for substitution in place of nickel-manganese in almost every instance. Field tests indicate that it can be as readily applied and that it has a ductility and tensile strength equal to or better than the nickel-manganese. It can be used for building up parts as well as for repairing fractures.

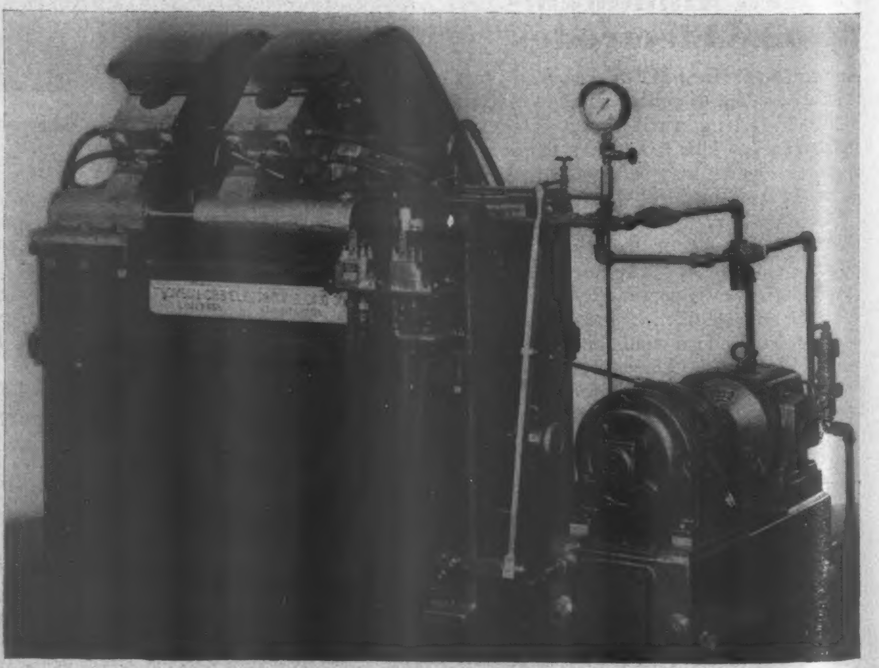
Flue Welder for The Railroad Shop

A flash welder for safe-ending and salvage work on locomotive boiler flues has been introduced by the Thomson-Gibb Electric Welding Co., Lynn, Mass. New features of design have been incorporated to make this machine—Model F-21—more useful in railroad flue welding shops. The 150-kva transformer is offset in the frame to provide a direct path for flash dirt to fall to the floor without striking the transformer coils or core. The slide bearings are set out at the ends well away from the line of the flash and the piston rods and linkage which operate the air clamps are shielded by a flash-proof hood.

Push-up pressure is supplied by a hydraulic cylinder and an oil pump. Dies for the smaller flues are arranged so that two different sizes can be handled by one set of die blocks. The dies are water cooled and are adjustable for vertical alignment by means of hand wheels at the front of the machine and they can be moved on the jaw members for further adjustment.

Accurate heat control is provided through ten points of heat regulation, five obtained through a switch on the machine and five by a simple change of connections on a terminal board. The 150-kva nominal rating is based on a 50-per-cent duty cycle. The primary may be wound for 220-, 440- and 550-volt, 60-cycle current. Arrangements can be made to furnish the machines for the same voltages on 25-cycle current.

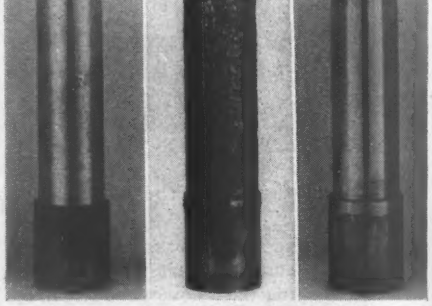
Flue sizes from 1¼ in. to 6 in. in outside dimensions can be accommodated, standard pipe from the same minimum to 4½ in. outside diameter. Extra heavy pipe from the same minimum to 3½ in. maximum, and double-extra-heavy pipe from the same small size to 2½ in.



Flash welder for use in flue shops

Electrodes for Tool Steel Welding

Fractured, or worn hot working steel dies, punches, shear plates, etc., are being successfully rebuilt by the use of tool-steel



Hot work upsetting punch—Left: As prepared for welding—Center: As welded—Right: After finishing, ready for use again

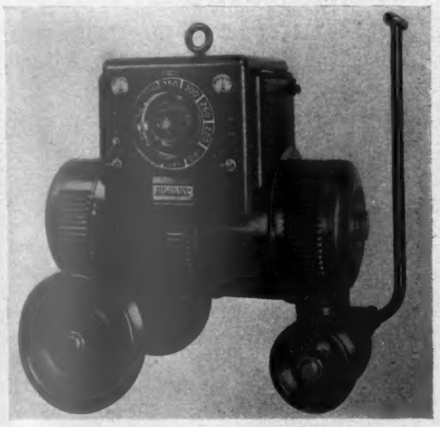
electrodes which give a metal deposit of the same characteristics as typical high-tungsten and chromium hot-working steels.

These electrodes, known as No. 72 Eureka hot-work tool-steel electrodes, contain additional alloying elements to improve further the deposit's air-hardening, hot-working qualities.

Under controlled welding conditions an ultimate Rockwell hardness of 54 to 56 on the C scale can be obtained. The deposit secured with the No. 72 electrode will take the heat treatment typical of hot-working steels. The Welding Equipment & Supply Co., Detroit, Mich., the manufacturer of these electrodes, also furnishes others for other types of tool-steel welding.

Portable 300-Amp. Arc Welder

Offering 1,000 combinations of voltage and welding current, without dead spots, the Hobart portable 300-amp. arc welder includes a number of design features which have recently been developed. The multi-



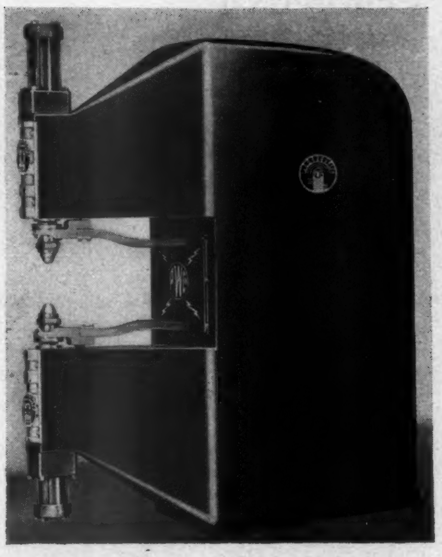
A 300-amp. motor-driven arc welder on which Hobart is concentrating production facilities

range dual control with 10 ranges of welding current and 100 steps of voltage in each range make available the 1,000 steps of open-circuit voltage and welding current for selecting any desired arc characteristics.

A volt-ampere adjuster is compactly built within the main switch and is easily removed if remote operation of the machine is desired. A built-in, four-pole exciter insures prompt building up of voltage and freedom from accidental polarity reversal. Convenient links make possible an easy change-over of motor connections from 220 volts to 440 volts. The Hobart Bros. Co., Troy, Ohio, manufactures and distributes these machines.

Controlled Weld Temperatures

Designed for resistance welding of heavy sections and of special alloy steels, the Temp-A-Trol is said to be completely automatic in controlling weld temperatures. It is self-compensating for variations in metal thickness, induction and short-circuit-



Temp-A-Trol self-regulating forge welder

ing losses, presence of scale and other factors which affect ordinary spot-welding operations. With completely automatic control of welding, heat treating and annealing cycles the human element in operation is reduced to selecting by dial regulators the actual temperatures desired. The Progressive Welder Company, Detroit, Mich., manufactures this machine.

Welding Positioners Increase Production

The primary function of a welding positioner is providing the ideal downhand welding position. Increased production and savings in labor cost are claimed by the Ransome Concrete Machinery Co., Dunellen, N. J., in cases where positioners are used. This company manufactures a full line of manually-operated and motor-operated machines for use in welding shops. The model illustrated is a 2,500-lb. hand-operated unit and the same capacity machine is also available with a motor attachment. Other sizes of 3,000-lb., three and eight tons' capacity are furnished with motors.

Ransome 2,500-lb. capacity, hand-operated welding positioner

The 2,500- and 3,000-lb. units can be revolved 360 deg. in either direction and tilted 135 deg. beyond horizontal. The larger sizes revolve 360 deg. in either direction and the table top tilts through a range of 45 deg. from horizontal in one direction to a vertical position in the other direction. The table spindles on all models turn in two Timken tapered roller bearings. Motor-operated positioners are furnished with individual constant-speed motors for tilting and rotating, although variable-speed motors can be supplied. Limit switches are provided on the tilting operation and motors shut off automatically at the two extreme positions of tilt.

Welding Goggles

An industrial welding goggle which with the heaviest lenses weighs only 3 oz. is offered by the Sellstrom Manufacturing Company, Chicago, for the use of welders. This goggle incorporates a patented method of indirect ventilation which provides a continuous flow of air into the eye cups and practically eliminates lens fogging. The frame of the goggles is made of a moulded plastic noted for exceptional strength and impact resisting qualities. The cups fit snugly and comfortably.

Nineteen Stages of Heat Control

An alternating-current arc welder designed to produce a smooth, uninterrupted welding arc at all heat stages has been introduced by the Marquette Manufacturing Company,

Marquette a.c. arc welder for fast, heavy-duty industrial service

Inc., Minneapolis, Minn. This unit, designated as Model No. 400 BBT, is a 400-amp. a. c. welder, in which extra-capacity, dual transformers furnish a flow of welding power from 19 positive-contact heating stages ranging from 45 amp. to 400 amp. These machines have a built-in automatic voltage control which eliminates the neces-

sity of manual adjustment and speeds welding. Variable power take offs are made from multiple outlets in a heavily insulated panel on the side of the machine. Solid tapered jacks and taps furnish a simple positive electrical and mechanical contact at all times and provide a high safety factor. These welders are so insulated that "around the clock" operation is possible. Mounted on a four-wheel iron truck, the machines can be moved from job to job.

Balanced polarity in a 60-cycle alternating current results in a stable, even arc throughout the welding operation and is said to provide freedom from magnetic blow common to d. c. welding currents.

Positioned Welding For Better Work

Manually or motor-operated welding positioners of small capacity and motor-operated units of large size are built by the Cullen-Friestedt Co., Chicago, Ill. The tables on all units tilt from horizontal to 135 deg. with a complete table rotation of 360 deg. available. The table tops can be removed to allow the use of special jigs and fixtures and a table height adjustment can be made to increase the usefulness of the positioner.

By providing a wide range of adjustments these positioners make it possible for welders to operate at all times in the most convenient working position and all welds are made in the downhand position

Positioner being used in welding Diesel locomotive motor frame

which is recognized as the one in which best welds are obtained.

Safety limit switches are provided on motor-operated models which cut off motors automatically when extreme positions of tilt are reached. Variable-speed motors on the rotating action permit the operator to adjust the speed of rotation and remain in one position while making a continuous weld.

Protective Control Device

A device developed by the Lincoln Electric Co., Cleveland, Ohio, is designed to provide complete protection against heat, excessive current, or both, on arc-welding machines. Operation at maximum capacity for long periods without harm to machines is said to be possible when this device is used. It consists of two current transformers, the primaries of which are connected in series with the motor leads with the secondaries supplying power to operate two snap-action thermostats which are mounted directly on the motor lamination.

In the illustration the transformers are shown in the top position and the thermostats at the lower indicated point. The thermostats are connected to the lamination in such a manner that they operate by

Welder equipped with protective control to prevent overheating

means of heat conduction as well as by current passing through them. The thermostats will trip open if the temperature in the room exceeds safe machine operating temperature; if the motor is cold and excessive, possibly damaging, currents occur; if the machine is started on single-phase lines; if the machine is operating and one fuse blows so that the motor is operating single-phase and overheats; if the rotor is locked with normal three-phase power attached; and if the welder is operated for long periods of time at sustained overloads. Thermostats reset automatically when the motor has cooled to a safe operating temperature.

Estimating Electrode Needs

Engineers, supervisors, purchasing agents, operators, and all others who use or supervise the use of arc-welding electrodes can obtain a copy of the new General Electric Welderule and save time in estimating electrode requirements. Operating in a manner similar to a slide rule, the Welderule reads directly the length of arc-welded joints obtainable per 100 lb. of electrode, also the pounds of weld metal deposited per 100 lb. of electrode. The information covers 11 different commonly used sizes and types of joints; also 22 different sizes and types of electrodes in general use in both the 14-in. and 18-in. lengths.

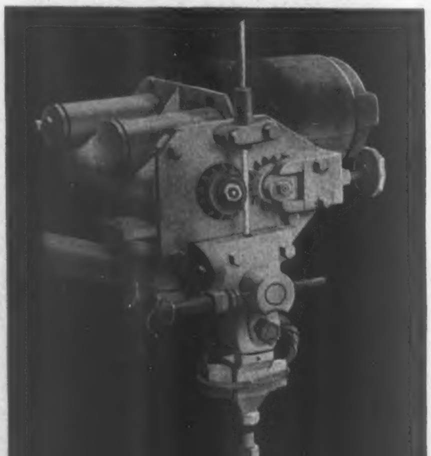
Although general data of a similar nature have been published in bulletin form, the Welderule enables more accurate estimates to be made because it applies to specific types and sizes of electrodes. Being of vest-pocket size, it is easy to handle and convenient to use.

An additional feature is a selector chart which shows the various filler metal classifications as specified by the American Welding Society and the types of electrodes which meet these classifications. The Welderule may be obtained from any local G-E arc welding distributor, G-E sales office, or from General Electric Company, Schenectady, N. Y.

Arc Welding Heads for Automatic Operation

Utilizing two electric motors, one of constant speed and the other of variable speed, inter-connected by differential gearing, the Unamatic arc welding head will maintain a constant arc of correct length on automatic arc welding operations. Arc voltage governs the variable-speed motor and determines the rate at which the electrode is fed to the work.

Sliding brush contacts energize the electrode in these heads and the welding wire is advanced by knurled knobs operated by the two motors. The constant-speed motor remains unaffected by voltage rise or drop in the arc while the variable-speed motor, which has the same r.p.m. at its lowest



Unamatic electric arc welding head

speed as the constant-speed motor, increases or decreases in speed as the arc voltage changes. This is the motor which compensates for any irregularity during welding, either of work or current, through increasing or decreasing its speed and, there-

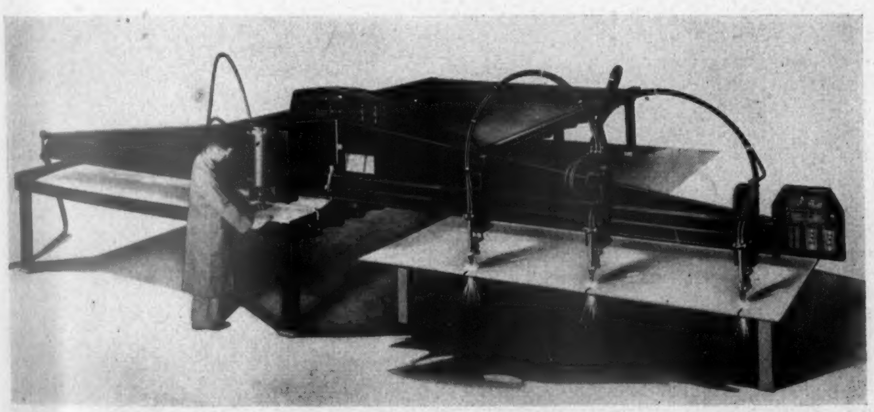
fore, the rate at which the electrode is fed to the work.

This equipment, which is said to be in successful use in several large railroad shops on center-sill welding and the building up of locomotive car wheel centers, is manufactured by Una Welding, Inc., Cleveland, Ohio.

Shape-Cutting Machines

Shape-cutting machines furnished by the National Cylinder Gas Co., Chicago, are designed to meet railroad requirements for cutting out main and side rods, spring equalizers and numerous other car and locomotive parts. By the use of an automatic spacer attachment the pre-heating flame is kept the proper distance from the plate being cut, whether or not there are variations in metal thickness. There is a central operating-control panel on the machine which is supplemented by an auxiliary control at the end of the carriage and from either point full control of operations is possible. The torches on the National Type R machine can be operated independently of each other, permitting the use of one cutting head on a straight cut while the other is following the pattern set on a tracing device.

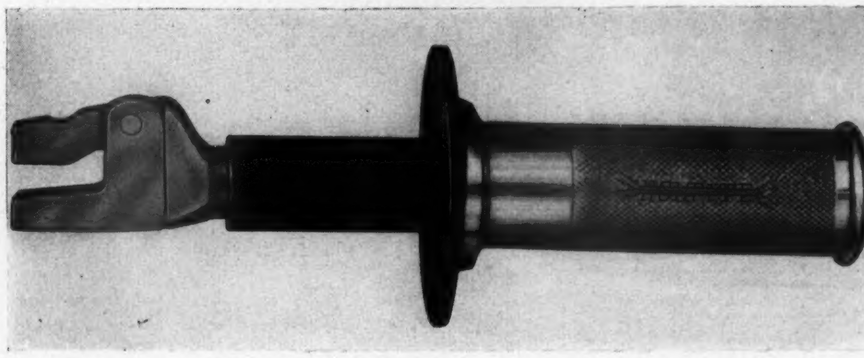
A cutting calculator is placed on the control panel of the machine and it gives the operator a ready-reference guide for tip size, speeds and pressures for any metal thickness. Bevel cuts can be made by checking the angle of each torch on a panel indicator.



National Type R multiple-cutting machine

Electrode Holder with Replaceable Jaws

Developed during actual welding service under all possible conditions from the lightest to the heaviest welding jobs, the Holtite electrode holder is designed to decrease operator fatigue and reduce heat transfer through the handle. Available in 300, 400 and 500 ampere models the holders are designed with replaceable jaws and a renewable insulating tube which separates the handle from the jaws. These features contribute to a longer service life per holder. The vise-like grip of the jaws on the electrode gives a positive electrical contact at all times. The holders are made by the Holtite Holder Co., Herrin, Ill.



Heavy-duty electrode holder with replaceable jaws

Low Priority Hard-Facing Rods

To serve companies unable to furnish high priority ratings, the Stoody Company, an affiliate of the Air Reduction Sales Co., New York, has developed two new hard-facing alloys which are being marketed under the trade names of Stoodite K and Stoody self-hardening K.

Stoodite K is a cast hard-facing rod consisting principally of molybdenum, tungsten, manganese, silicon, carbon, and iron. It is supplied both in bare form for oxy-acetylene application and in coated form for d. c. electric application, and is recommended for hard-facing operations on equipment subjected to abrasive wear.

Stoody self-hardening K is composed principally of molybdenum, manganese, silicon, carbon, vanadium, and iron, and is made in the form of tubes with the mixed alloys on the inside. This rod is also available for oxyacetylene and d. c. electric arc applications.

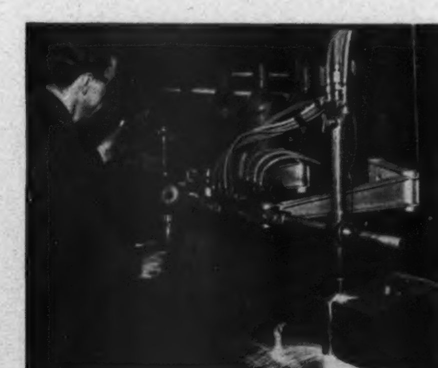
In addition to being highly resistant to wear, Stoody self-hardening K will also withstand considerable impact if properly supported. It forms an excellent bond with manganese steel and can be used for hard-facing various types of manganese equipment. Deposits can be forged providing forging is done at red heat. It is recommended for hard-facing parts subjected both to severe wear and impact.

Both Stoodite K and Stoody self-hardening K are available under the regular A-10, P-100 rating.

High-Speed Tips For Machine Cutting

Designed to fit standard machine-cutting torches, the Airco "45" high-speed cutting tip has been developed by the Air Reduction Sales Co., 60 East 42nd street, New York. Increased cutting speeds of from 20 to 30 per cent are said to be effected, with the cuts being of comparable quality to those obtained with standard tips.

The new tip has a nozzle with a divergent exit portion, a design that makes it possible to eject a narrow, high-velocity stream of oxygen, practically free of exit turbulence. A narrower path or kerf through the metal is said to be obtained when using this tip. High operating pressure is required and the velocity of the oxygen stream is further increased by the divergent tip which provides a higher oxygen concentration at greater depths in the metal being cut. The tips are available in a range of sizes for cutting metal thicknesses up to eight inches.



Airco "45" high-speed machine tip cutting 6-in. alloy steel

High Spots in

Railway Affairs . . .

Passenger Car Section Established

The Association of American Railroads has announced the formation of a Passenger Car Section of the Car Service Division. Edwin F. Bilo is the manager and the section will have its headquarters in the A.A.R. offices in the Transportation Building at Washington, D. C. Obviously the shortage of passenger equipment and facilities under wartime conditions makes it necessary for the railroads to co-operate much more intimately in the handling of passenger traffic than under normal conditions. The principal purpose of the Section will be "to obtain the greatest practical efficiency in the use and handling of passenger train equipment."

Public Aids to Transport

The Board of Investigation and Research, authorized under the Transportation Act of 1940, has announced that it will open public hearings in Washington, D. C., on June 29, in connection with the investigation of public aids to transportation. This will afford opportunity for interested parties "to present basic statistical data and to submit evidence bearing on the principles and methods which may be applied in determining the extent of public aids and in allocating the cost of such aids." The announcement includes a number of specific items relating to highway, railway, waterway, airway and pipe line transportation, although evidence submitted will not be limited to the suggested questions. It is expected that the hearings will be concluded before July 4.

Runs Interference For the Railroads

John W. Barriger, III, associate director of the Office of Defense Transportation, and also federal manager of the Toledo, Peoria & Western, has a colorful personality and is kept everlastingly on the run with his various assignments. In speaking at an economic conference of the National Association of Mutual Savings Banks, he pointed out that railroad service is a highly perishable commodity that cannot be ordered far in advance, or stored until wanted. He also noted that in their preparations to meet the national emergency, the railroads had not been given aid, as have other industries, by a Defense Plant Corporation set up to relieve them from financial liability for new facilities that may not be needed under post-war conditions. In spite of this, the railroads alone, of all the industries affected by war-time demands, have made a hit every time they have gone to bat. In defining the purpose of O.D.T. and its relationship to the railroads, he said that to provide transportation in the rapidly increasing quantities that the war effort will demand, private management needs such an organization as the O.D.T. that understands its necessities and can "run intereference" for it in sweeping obstacles out of the way.

Personnel Problems

We are so accustomed in these days to speak in astronomical terms that sometimes we fail to comprehend the immensity of a task that deals only in terms of thousands or tens of thousands. When we have struggled hard, however, to find a man to replace satisfactorily a single selectee, we are more likely to appreciate the significance of the statement made by Director Otto S. Beyer, Division of Transport Personnel, O. D. T., that we will require 320,000 new railroad hirings for the rest of 1942, dating from May 1. Director Beyer estimates that 117,000 new railroad jobs will be created by wartime expansion and the October car loading peak, 22,000 will be required to replace men inducted into the armed services, 167,000 for turnover, and 14,000 to provide for the vacations which many railway workers were granted by the Emergency Board award of December, 1941. Incidentally, these figures do not include casual jobs of a few days' or a few week's duration.

Grade Crossing Accidents Increase

In the first three months of this year 562 persons were killed and 1,580 injured as the result of grade crossing accidents. This compares with 525 killed and 1,380 injured during the same period last year. Delays to the movement of war materials because of these accidents are not inconsiderable. The Safety Section of the Association of American Railroads finds that the delay to freight trains alone averages about 460 hours per month. In spite of the hazards involved, motorists fail to take proper precautions in approaching and passing over highway-railroad grade crossings. This is emphasized by the fact that 82 per cent of these accidents take place at crossings having special protection, consisting not only of the standard sign that warns motorists they are approaching a grade crossing, but also some special device such as flashing lights, gates or watchmen. In one-third of the accidents motorists actually drove into the sides of trains. Another disturbing fact is that about 80 per cent of these grade crossing accidents involve motorists at crossings in the vicinity of their homes.

Ore Moving Over Great Lakes Fast

When the last ore boat left Duluth early in December, 1941, Ralph Budd, at that time defense transportation commissioner, announced that "the all-time record for ore transportation on the Great Lakes was exceeded by nearly 15 million tons during the past season." In all, more than 80 million gross tons of ore had been handled over the Great Lakes. The 1942 goal is 89,500,000. That a splendid start has been made toward achieving this goal is indicated by the fact that iron ore shipments up to May 1, this year, amounted to 8,581,740 gross tons, an increase of 1,626,947 tons, or 23.9 per cent over the same period in 1941. Under orders of the Office of Defense Transportation, grain traffic over the Great Lakes was on May 15 discontinued in vessels capable of carrying iron ore.

"Trade Barriers" Hamper Traffic

Lieut. Gen. Brehon B. Somervell, chief of the War Department's Services of Supply, was most fittingly chosen as the concluding speaker at a three-day conference of federal and state officials, called by President Roosevelt to consider certain state laws and regulations which have proved to be handicaps in our war efforts. General Somervell declared that, "we have found numerous instances of unreasonably rigid enforcement of state trucking regulations that have delayed highway shipments of vital war materials. Truck drivers have even been sent to jail for technical violations and state and local officers have stubbornly refused to use common sense in the matter of loading laws. We find the same trouble in rail transportation. If we're going to use our rails to the fullest extent to win this war, we're going to have to relax special limitations on train lengths and similar matters."

Ickes Hard to Satisfy

Petroleum Co-ordinator Harold L. Ickes, in an address at Boston, Mass., on May 27, indicated that the railroads and the oil companies had done a superb job in carrying oil to the East Coast by tank car. He went on to say, however, that he wished "the railroads had not fought the pipe lines as vigorously and misfortunately as they did." The latest figures available when this was written were for the week ended May 16. They showed that 684,482 barrels of oil had been handled daily by the railroads in tank cars during that week. The 26 oil companies participating loaded 21,295 cars.

NEWS

WPB Turns Down Eastman Plea for More Equipment

The War Production Board has refused to alter its recent decision allocating materials for production this year of only 18,000 freight cars and 300 locomotives in addition to the 44,150 cars and 926 locomotives contemplated in schedules previously approved by the former Supply Priorities and Allocations Board. While WPB made no announcement of its decision, it was learned that no additional materials will be forthcoming as a result of the recent rehearing on the matter which it gave Director Eastman of the Office of Defense Transportation.

Eastman Sees Carriers Handling 12 to 15 per cent More Traffic This Year

Predicting an increase this year in carloadings of 12 to 15 per cent over those of last year, Joseph B. Eastman, Director of the Office of Defense Transportation, told the Truman defense investigating committee on April 23 that he felt the railroads would be able to handle this increased amount of traffic despite a "tight" situation in some types of equipment. Mr. Eastman had been called before the Senate committee to bring it up-to-date on the question of transportation and its relation to the war effort.

In regard to locomotives, he noted that because of the east coast oil situation due to submarine sinkings and tanker diversions, the carriers are now hauling some 600,000 barrels of oil a day as compared with 70,000 barrels in December. This movement, he continued, is using 850 locomotives, thus causing a tight situation in some localities. He also pointed out that bananas are now moving by rail from New Orleans to New York, thus throwing an added burden on the railroads. In addition, he told the committee that there has been a reduction of 40 to 50 per cent in the coal movement by water to the New England ports, and his office hoped to divert some of the lake cargo coal to rail movement to speed up the hauling of iron ore.

More equipment, better use of existing equipment, and a reduction in the amount of railroad work were listed by the ODT chief as ways of meeting the problem of increased traffic on the railroads. Among the specific suggestions which Mr. Eastman made in discussing the latter was an inventory of the locomotive situation. In this connection he told the committee that other roads had already loaned locomotives to the Southern Pacific and the Boston & Maine.

On the subject of obtaining more new equipment than that already authorized by WPB, Mr. Eastman preferred not to express definite opinions. He felt, however, that the capacity of the locomotive plants should not be decreased and that there will have to be more open-top cars than originally contemplated.

Emergency Board Procedures

Acting upon the recent suggestion of railway labor leaders, President Roosevelt has made public a May 21 executive order setting up for the duration of the war procedures whereby labor-management disputes in the railroad industry may be submitted to emergency fact-finding boards without the necessity for the taking of a strike vote among labor organizations involved. The President, who made the announcement at his May 22 press conference, said that his action comprised a follow-through from the suggestion of the labor leaders, and he added that it had the approval of the Association of American Railroads.

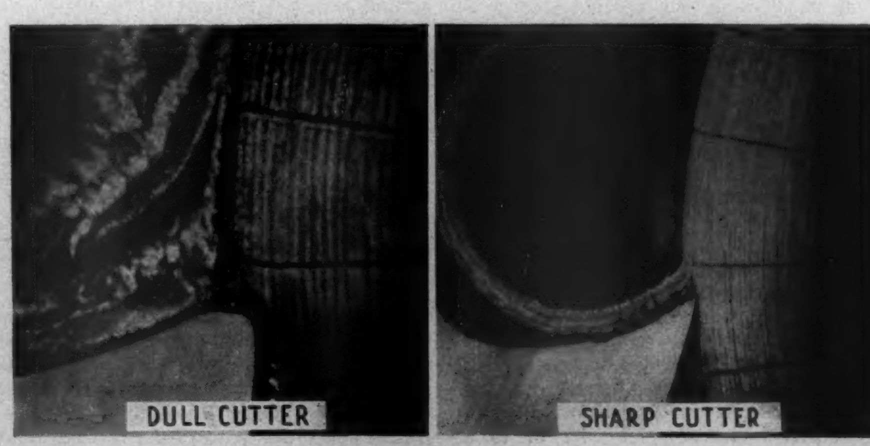
The order creates a panel of nine members, one of whom shall be designated by the President as chairman. From that panel, emergency fact-finding boards would be appointed by the chairman. The plan contemplates that when a wartime dispute reaches the stage where under normal procedures a strike vote would be taken, "the duly designated and authorized representatives of employees involved in such dispute, may, prior to notice by the National Mediation Board to the President of a threatened interruption to commerce, notify the chairman of the panel of the failure of the parties to adjust their disputes and of their desire to avoid the taking of a strike vote and the setting of a strike date." If, in the judgment of the chairman, the dispute is such "that, if unadjusted, even in the absence of a strike vote, it may interfere with the prosecution of the war, he may thereupon select three members of the panel to serve as an emergency board to investigate such dispute and to report thereon to the President."

Thus, only labor can invoke the services of the panel. Also, a dispute could still reach the usual type of emergency board, if there were a threatened strike as a result of dissatisfaction with the recommendations of a board created by the panel. However, as the White House announcement pointed out, the procedure was set up "in view of the fact that American labor generally has agreed that during the war there shall be no strikes." Nevertheless, the executive order specifically protects section 1 of the Railway Labor Act, which contains the emergency board provisions, when it stipulates that the "exclusive and final jurisdiction" conferred on a board appointed from the panel shall be "subject to the provisions of section 10." As the White House announcement put it: "The executive order does not seek to amend the Railway Labor Act which has worked so well for many years. It merely sets up for the duration of the war an extra-statutory panel which will provide a means of adjusting disputes without actual strikes."

Members of the panel were not immediately announced by the President, who said he had not decided on who would be appointed. The chairman is to receive such compensation and expenses as the President may prescribe; while the other members will receive expenses or a per diem allowance for the time they are actually on assignment. Qualifications for membership are the same as those provided in section 10 for membership on emergency boards.

Metal Cutting Film

"Chips" is the title of a new sound film that has been produced for the Warner & Swasey Company as a part of its Turret Lathe Operator's Service Bureau program for the training of operators. The service includes a staff of instructors trained in the technique of grinding and setting up cutting tools which are available to conduct one-hour programs in industrial plants using metal-cutting tools. The program



From the sound film "Chips"

involves the use of model tools, giant model cutters, and charts, in addition to the sound film, and all operators who attend receive a 16-page booklet featuring the high spots of the instruction. The instructors and film are available without charge.

The booklet is an interesting supplement to the sound film in that it provides a permanent reference to the important points which the film dramatizes. It contains sections on the selection and grinding of cutters and illustrated notes on the functions of cutting tools and the manner in which improper grinding of the cutter or the improper setting of the cutter in the tool holder can easily defeat the purpose of the cutting tool—to remove metal. The sound film shows at 1/100th actual cutting speed exactly what happens when a cutter is ground incorrectly. It also includes instruction in the use of chip grooves, control of size and length of chips, function of coolants and the advantages of honing cutters.

Auto-Loading Devices Improperly Secured

With the curtailment of automobile production, a number of railroads are using cars equipped with automobile-loading devices in general service. When cars are so used, it is necessary that the racks be properly anchored in the roofs of the cars and fastened in such a manner that there is no danger of their dropping on the lading underneath. These necessary precautions are not being taken in all instances and lading is being damaged, according to C. H. Buford, vice-president, A. A. R., Operations and Maintenance department, who requests that, when the racks have not been permanently fastened to the roofs of the cars, they be engaged in the anchor hooks provided and, in addition, be secured by means of wire or other fastenings so there is no possibility of their shaking loose and falling on the lading underneath. This is particularly important when device cars are used for war equipment or material essential to the war production effort.

Processed Parts May Now Be Shipped to Car Builders

The War Production Board has now made clear that freight-car producers may accept deliveries of parts and materials from suppliers if they are not subject to other rated orders, despite the fact that all preference ratings of A-2 or lower assigned to freight-car producers were recently cancelled.

Amendment No. 1 to Supplementary General Limitation Order L-97-a-1 clarifies the original order issued April 29, which prohibited producers from accepting delivery of material for car construction on orders rated A-2 or lower which was not in transit to them on that date. The amendment provides that suppliers may dispose of inventories of processed or partly-fabricated parts, if deliveries can be made to producers as on unrated orders.

Under the terms of the amendment, any producer or supplier may sell or deliver to any other producer or supplier or to a railroad any parts manufactured from materials obtained under a preference rating. "This," said the WPB announcement, "will permit balancing of inventories, and will assure maximum utilization of inventories. The original order gave this sale and exchange privilege to producers only."

Orders and Inquiries for New Equipment Placed Since the Closing of the May Issue

Locomotive Orders

Road	No. of Locos.	Type of Locos	Builder
Boston & Maine	6	5,400-hp. Diesel-elec.	Electro-Motive Corp.
Chicago & Eastern Illinois	1	600-hp. Diesel-elec.	Baldwin Loco. Wks.
Detroit, Toledo & Ironton	4	2-8-2	Lima Locomotive Wks.
Minneapolis, Northfield & Southern	1	660-hp. Diesel-elec.	Baldwin Loco. Wks.
Newburgh & South Shore	2	660-hp. Diesel-elec.	American Loco. Co.
Peoria & Pekin Union	1	1,000-hp. Diesel-elec.	American Loco. Co.
St. Louis-San Francisco	5	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Western Maryland	3	660-hp. Diesel-elec.	Baldwin Loco. Wks.

Locomotive Inquiries

Road	No. of Locos.	Type of Locos	Builder
Lehigh & Hudson River[1]	3	4-8-2	....
Western Pacific	6	2-8-2	....

Freight-Car Orders

Road	No. of Cars	Type of Cars	Builder
Bessemer & Lake Erie	800[1]	90-ton hopper	Pull.-Std. Car Mfg. Co.
Phelps Dodge Corp.	190[1]	90-ton ore	Western-Austin Co.
Republic Steel Co.	10	50-ton hopper	American Car & Fdry. Co.

[1] Unconfirmed.

Order Facilitates Exchange of Car Materials Inventories

"In order to make full use of existing inventories in the hands of all freight-car makers before permitting them to receive additional raw materials," the War Production Board has issued an order cancelling all preference rating of A-2 or lower on material for car construction which has not already been received by, or placed in transit to, the producers.

At the same time, the order, Supplementary General Limitation Order No. L-97-a-1, effective April 29, permits any producer to sell and deliver any material which he has on hand or in transit to any other producer of freight cars. "This will permit balancing of inventories between producers by sale or exchange, and will assure maximum utilization of all supplies now on hand," said WPB announcement.

It was explained that the supplementary order was issued because some producers now have larger inventories of certain types of material than they will be allowed to use under this year's freight-car building program as authorized by the Requirements Committee of WPB. The WPB has approved the construction of only 18,000 freight cars this year, over and above the 45,000 cars contemplated in the previous authorization by the former Supply Priorities and Allocation Board program announced last fall.

The number of cars to be built by each producer is being scheduled by the Transportation Branch of the WPB, and the order will allow producers to transfer to other manufacturers materials in their inventories which are in excess of the amount required for the number of cars they will be permitted to build.

Amendment No. 1 to General Limitation Order No. L-97, also announced, excludes mining locomotives from the provisions of that order. This action was taken because priorities for mining locomotives are controlled under the terms of the Mining Machinery Order, P-56. The manufacture and distribution of such locomotives are controlled by the preference rating orders administered by the WPB Mining Branch.

Railroad Shops to Produce War Materials

Full use of railway-shop facilities, wherever available, to help in the production of war materials, was unanimously agreed to by railroad management and the railroad shop crafts at a recent meeting with representatives of the War Production Board, the Department of Labor, and the Office of Defense Transportation. Announcement of the agreement was made on May 13 by Director Eastman of ODT who presided at the conference.

In agreeing to WPB's request for use of the railroad shops, the representatives of the shop-craft unions "expressed the desire that first consideration be given to the utilization of all available shop facilities for the manufacture of railway equipment such as new cars and locomotives." Meanwhile, Mr. Eastman said, the shops may be asked to consider the production of items used in military and naval equipment, in marine transportation, and in the manufacture of munitions and other war materials.

The ODT director commended the employees' unanimous agreement to work on war materials at railroad basic shop pay, and on the rail shop's 48-hour-week schedule. He pointed out that labor employed on government contracts in other industries works under the provisions of the Walsh-Healey Act on a 40-hour-week basis, and "in many cases at higher hourly wage rates." The Department of Labor, at the request of the War and Navy Departments, has agreed to exempt the railroad industry from the provisions of the Walsh-Healey Act. Mr. Eastman also commended railroad management, calling its willingness to cooperate "another demonstration of the manner in which the railroads are facing the war emergency."

A committee headed by Otto S. Beyer, director of ODT's Division of Transport Personnel, and composed of two other members representing the government, three from the railroad unions, and three from railway management, will be set up to exercise general supervision of the plan.

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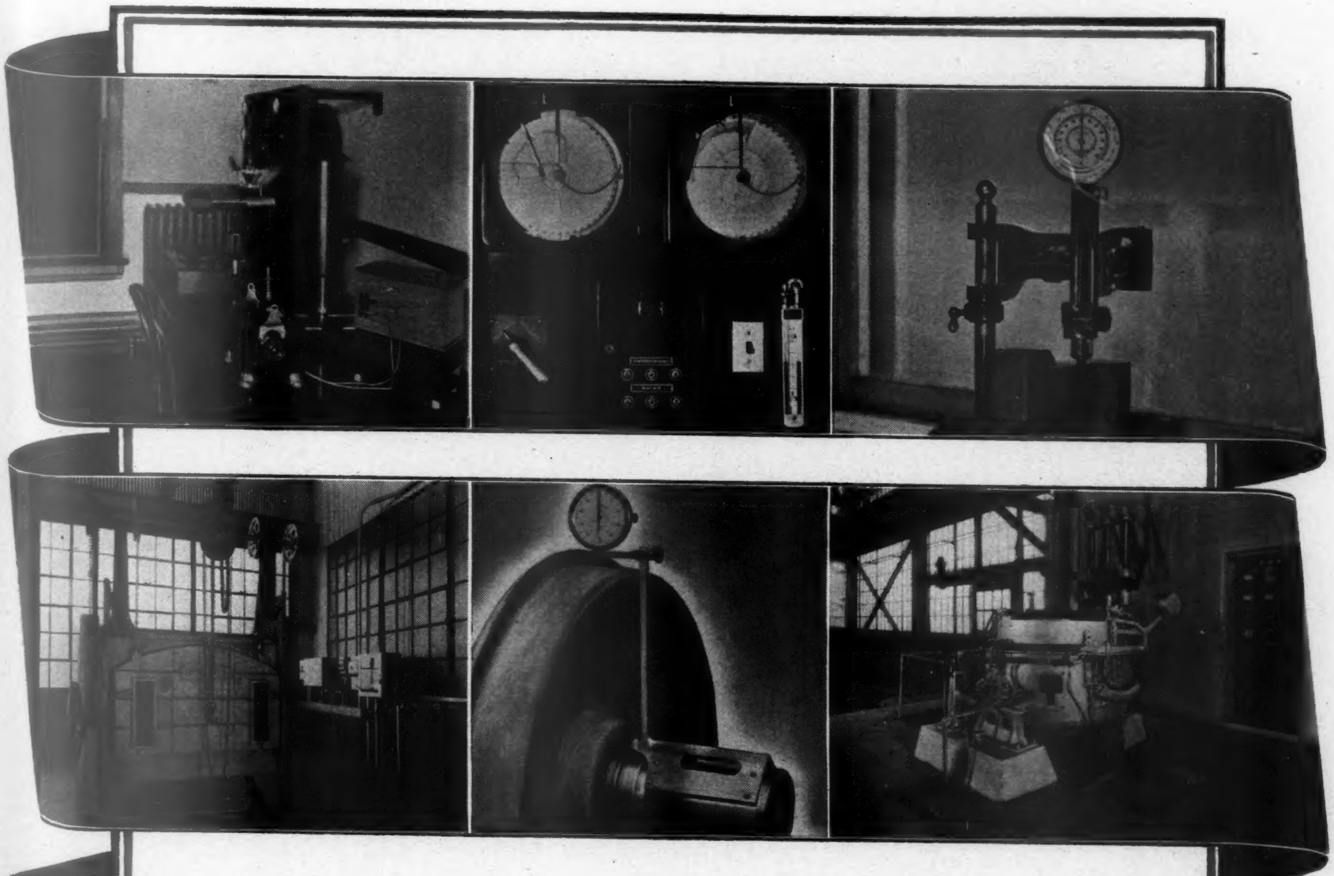

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Use of the shops, under the agreement with WPB, will probably be arranged through contractors and subcontractors, Mr. Eastman indicated. It is estimated that 75 major shops and more than 400 back shops, employing 150,000 men, will be affected.

Carriers to Train Military Railroaders

MAJOR railroads of the United States are cooperating in the establishment of the Military Railway Service, Corps of Engineers, according to a recent War Department announcement.

Initially, the Southern, the Atchison, Topeka & Santa Fe and the Pennsylvania each will train an engineer battalion (railway operating), while the New York Central will train an engineer battalion (railway shop), the announcement said. Each battalion is in command of a lieutenant colonel.

Headquarters for the Military Railway Service are at Fort Snelling, Minn. Colonel Carl R. Gray, Jr., Engineer Reserves, formerly executive vice-president of the Chicago, St. Paul, Minneapolis & Omaha, has been called to active duty and will be in charge of the service. He will have direct charge of training all men for the Military Railway Service.

In an address before the Freight Claim Division, A. A. R., on April 29, Colonel Gray said that the headquarters organization will include an Operating Department, in charge of a general superintendent of operation—N. A. Ryan, who was general manager, Western Lines, Chicago, Milwaukee, St. Paul & Pacific, and who now has the military rank of colonel; an Engineering Department, in charge of an engineer maintenance of way—B. H. Crosland, who was division engineer, St. Louis-San Francisco, and who now has the military rank of lieutenant colonel, and Mechanical and Stores Departments. The organizations of the latter are as follows:

Title in Service, Military Rank, Name, and Previous Title on Railroad

MECHANICAL DEPARTMENT

Chief mechanical officer, Colonel W. G. Knight, (Mech. supt. B. & A., Derby Me.)

General superintendent motive power, Colonel J. K. Tully, (Asst. to v.-p. eng. research Pullman Co., Chicago, Ill.).

Superintendent car dept., Major F. E. Cheshire, (Asst. supt. car dept. M. P., St. Louis, Mo.).

Assistant master car builder, Captain H. L. Thomas, Jr., (Mech. eng. Penna., Philadelphia).

Assistant car department, 1st Lieutenant G. E. Hargraves, (Mech. eng's off. Penna., Philadelphia).

STORES DEPARTMENT

General storekeeper, Lieutenant Colonel E. F. McFadden, (Gen. st. keep. U. P., Pocatello, Idaho).

Fuel agent, Captain F. T. Richards, (Spec. purch. agt., P. R. R.).

In addition to the four battalions to be trained by the railroads, the Corps of Engineers is training a battalion in Louisiana. The 711th Engineer Battalion (railway operating), originally was formed at Fort Belvoir early last year. Later in the year the battalion was sent to Louisiana where the Government bought and built a short railroad, now known as the Camp Claiborne-Camp Polk.

Each operating battalion is made up of headquarters and service company and three additional companies whose combined operations are the same as the operation and maintenance of a railroad division, it was pointed out.

The shop battalion also consists of a headquarters company and three additional companies performing equivalent functions to the "back shop" of the railroad, handling the heavy repairs on locomotives and cars. This battalion is in charge of Lt. Col. E. T. Leake who was formerly at the Beech Grove shops of the Cleveland, Cincinnati, Chicago & St. Louis.

This program is expected to furnish a number of Engineer Battalions composed of men who know every phase of railway operation and are able to perform it under actual war conditions, the announcement concluded.

A. J. Kruger Resumes Direction of C. D. O. A.

DURING the absence on military service of F. E. Cheshire, president of the Car Department Officers' Association, the duties of the president's office will be assumed by A. J. Kruger, superintendent car department, New York, Chicago & St. Louis, who is a past president of the association and at present chairman of the General Committee. This action is in accordance with provisions of the constitution and will be effective until the return of Mr. Cheshire or until an annual meeting is held. Mr. Cheshire has been appointed superintendent car department, Military Railway Service, and holds the commission of Major, U. S. A.

Coupler Reclamation

ACCORDING to a circular letter recently sent to members of the Association of American Railroads, Mechanical Division, by Secretary A. C. Browning, tests of welded couplers and cast-steel coupler yokes are being conducted by the Committee on Couplers and Draft Gears in co-operation with the Subcommittee on Welding of the Committee on Car Construction and the coupler manufacturers to determine to what further extent these parts may be reclaimed by means of welding. Preliminary tests apparently show that, in the interests of conserving critical materials, the present 40 per cent minimum for welding cracks and fractures may be safely extended, and a final report and recommendations will be sent to the members just as soon as the tests are completed. In the meantime, in view of the possibility of reclaiming many couplers which are now being scrapped, it is suggested that the member lines hold their failed couplers for possible future reclamation.

New Tank Car Record Set by Carriers

THE tank-car movement of oil into the east coast area soared to a new all-time high with an average of 684,482 barrels a day for the week May 16, according to an announcement of Petroleum Coordinator Harold L. Ickes. This was an increase of 13.4 per cent over the preceding week, when the movement averaged 652,082 barrels a day. Oil shipments from California to Oregon and Washington also reached a new record level of 29,636 barrels daily. The previous high was 29,429 barrels attained during the week ended May 2.

In handling the week's movement into the east, the 21 oil companies participating loaded 19,926 cars. Including cars that were on the way back west for reloading, it is estimated that the east coast service was employing about 48,650 cars, taken largely from other sections of the country.

Priorities

THE following are references to orders of interest to railroads issued by the War Production Board since April 18:

Air conditioning—Limitation Order L-38, issued May 15, places rigid restrictions on the production and sale of air conditioning and commercial refrigeration equipment. For 90 days, only the Army, Navy and Maritime Commission will be entitled to contract for the production of low temperature mechanical refrigerators designed to store frozen food or individual room coolers. After that time, production of these items must be stopped completely. The order prohibits the installation, effective immediately, of any new equipment except on preferred orders and these orders apply only to the Maritime Commission, certain other government agencies, Lend-Lease requirements and persons possessing a preference rating of A-9 or higher issued directly to them and designating the type of equipment desired.

Alloy iron and steel—Amendment No. 3 to Supplementary Order M-21-a, issued May 11, provides that no alloy iron or steel may, after June 1, be melted or delivered to fill orders with ratings lower than A-1-k, except for certain National Emergency and other low alloy steels which may be produced for orders down to A-3 ratings. Purchasers, after June 1, must accompany each order with a statement giving the end use to which the materials ordered will be put, the date on which delivery is needed and a statement that the delivery date is not earlier than necessary for the purchaser to meet his own delivery or production schedules. Meltings and deliveries must be made in accordance with schedules approved by the Director of Industry Operations.

Brass and wire—An amendment to Order M-9-a, issued May 7, limits shipments of brass mill, wire mill and foundry products to ratings of A-1-k or higher, unless specific authorization is given for a lower rated shipment. Deliveries previously were permitted down to A-10 ratings.

Copper products—A revision of Order M-9-c prohibits the use of copper and its alloys, including brass and bronze, in an additional hundred-odd civilian products after June 15 and orders other restrictions. Materials for railroads banned by the order include air conditioning equipment, except for essential repairs and parts necessary for conducting electricity; bands on pipe covering; decorative, general, and finish hardware, and ornamental metal work; door knockers, checks, pulls and stops; doors and windows, door and window frames and window sills; drinking water reservoirs; lighting fixtures, except for parts necessary for conducting electricity; pipe, tube, tubing, and fittings for plumbing and heating, except for essential repairs; shower rods, heads and pans; sinks and drainboards; screens and screenings; towel and luggage racks; water containers for humidification; weather stripping and insulation.

Fuel oil—Order M-144, issued May 5, discontinues preference rating to purchases of fuel oil. The action was taken to prevent companies entitled to the use of a preference rating under a blanket rating order from laying in large stocks of fuel oil while other companies and individuals were unable to obtain necessary supplies.

Machine tools—Order E-1-b, effective May 2, places all new critical machine tools under a limited allocation system by WPB. The order apportions each producer's monthly deliveries of each size of each type of tool, 75 per cent to service purchasers and 25 per cent to other purchasers, the 25 per cent for other purchasers to be divided among foreign purchasers and essential industries in this country and Canada and to be scheduled for delivery in accordance with preference ratings. Any producer who has received rated purchase orders for foreign and other purchasers exceeding 25 per cent of his production of any size of any type of tool for any month, is required to report such orders for analysis and further directions with respect to deliveries. The order, as amended May 15, requires purchasers to include in their orders to manufacturers specifications or other description in sufficient detail to enable the producer to place the tools in his production schedule.

Rubber treads—Limitation Order L-111, effective May 7, prohibits deliveries of rubber-tired hand trucks, of rubber tires for replacement purposes, without special authority, and of all other

(Continued on next left-hand page)

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Speed alone has never been a restriction of the steam locomotive, but the ability to maintain today's schedules while hauling increased trainloads is a quality that is only possessed by Modern Super Steam Power. For years Lima has done extensive research work in the development of the Super Steam Locomotive. The latest development from the Lima shops is the "Allegheny type" 2-6-6-6 locomotive. These locomotives are proving so successful in hauling the freight of the C & O over the steep grades of the Allegheny Mountains that the Chesapeake & Ohio has placed an additional order for ten more locomotives to be built to the same specifications as the engine illustrated above.

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uses of rubber in the manufacture or assembly of the trucks. These trucks are used principally to transport small quantities of materials in and around factories, railroad stations, warehouses, docks, etc. Exceptions are granted where the use of rubber tires is necessary to prevent explosion hazards and to avoid accidents in the handling of explosives or damage to delicate instruments which are an integral part of the truck. Application for authority may be made by filing form PD-468.

Safety supplies—Order L-114, effective May 5, imposes strict regulations on the use of aluminum, copper, plastics and several other commodities in the manufacture of safety equipment. The order prohibits the use of scarce materials in the items listed except for A-2 or higher-rated orders, if the equipment was manufactured prior to the date of the order or from parts ready for assembly on the date of the order. The materials are aluminum, asbestos cloth, chromium, copper, copper base alloys, nickel, corrosion-resisting steel, alloy steel, tin, synthetic plastics, magnesium, rubber, synthetic rubber and neoprene.

Iron and steel—Order M-21, as amended on April 22, restricts deliveries of iron and steel products to preference ratings of A-10 or higher after May 15. The order previously applied to steel products only and the inclusion of iron means that the 2,700 iron foundries in the country must comply with its provisions. Warehouses may deliver carbon steel on unrated orders when the purchaser specifies that the material is to be used for repair and maintenance, but each warehouse is limited, by quarters, to three per cent of its quota for any product for such deliveries. Persons other than producers may deliver on unrated orders nails and small black or galvanized welded pipe.

Nickel scrap—Order M-6-c requires the segregation of scrap containing more than one-half of one per cent nickel by weight and permits its melting only for authorized uses. Nickel scrap must not only be kept separate from other scrap, but various grades and degrees of content of nickel scrap must be segregated by all persons who handle it. Purchase orders for nickel scrap or secondary nickel must bear a certification that the purchaser is authorized to receive nickel and that the material will be used only as permitted by the order. Reports are required by the 15th of each month from persons who produce or have on hand scrap containing more than 500 lb. of nickel content per month, and those who have on hand at the end of a month more than 30 days accumulation of scrap if the nickel content is more than 100 lb.

Priority rules—Effective April 23, all applications for priority assistance, which do not specify a required delivery date, will be returned as prescribed by Priorities Regulation No. 1 as amended, requiring every applicant to specify the latest date on which the items can be delivered to meet obligations or production schedules.

Steel survey—A complete survey of the use of metal in the United States during the first quarter of 1942, and of anticipated requirements for the quarter beginning July 1, was begun on April 20 with the mailing of form PD-275 to all users of metal in raw or semi-fabricated form. The questionnaire is a refinement of the questionnaire sent to 11,000 manufacturers on January 30. The new survey also covers mines, railroads, ship yards, utilities, construction jobs and the petroleum industry, as well as military and naval contractors. To avoid duplication, only the uses and requirements of metal in raw and semi-fabricated form will be reported.

Freight car materials—Supplementary General Limitation Order L-97-a-1, effective April 30, permits producers of freight cars to deliver any material on hand to other producers of freight cars. The number of cars to be built by each producer is being scheduled by the Transportation Branch of WPB, and the order will allow producers to transfer to other manufacturers materials in their inventories which are in excess of the amount required for the number of cars they will be permitted to build. At the same time the order cancels all preference ratings of A-2 or lower on undelivered material for car construction.

Amendment No. 1 to Supplementary General Limitation Order L-97-a-1, permits freight car producers to accept deliveries of parts and materials from suppliers if they are not subject to other rated orders, despite the fact that all preference ratings of A-2 or lower assigned to freight car producers were cancelled April 29. The amendment permits suppliers to dispose of inventories of processed or partly-fabricated parts, if deliveries can be made to producers as on unrated orders. This will permit balancing of inventories and assure maximum utilization of inventories. The original order gave this sale and exchange privilege to producers only.

Supply Trade Notes

W. R. Kuhn has been appointed district manager, Cleveland, Ohio, office of the Allegheny Ludlum Steel Corporation. Prior to his new appointment, Mr. Kuhn was assistant district manager at Cleveland.

Frank U. Hayes has been appointed assistant sales manager of the Bullard Company at Bridgeport, Conn. Mr. Hayes, who becomes assistant to E. Payson Blanchard, sales manager, joined the Bullard Company in 1935 and was appointed sales representative in the middle Atlantic territory in September, 1936. In 1941, he became a technical advisor in the tool section of the production division of the OPM and, upon his return to the Bullard Company, established the firm's sub-contracting division.

The Cincinnati Milling Machine Company and the Cincinnati Grinders, Inc., are now serving their customers in New York state and New England through their sales subsidiary, the Cincinnati Milling & Grinding Machines, Inc., with district offices located in New York, Hartford, Conn., Boston, Mass., and Buffalo and Syracuse, N. Y. Henry Prentiss & Co., who have acted as the companies' exclusive dealer in New York state and New England since 1887, have retired from active business.

Lester E. Godsell, mechanical engineer, has joined the sales force of the Miller-Lewis Railroad Equipment Corporation.

N. H. Brodell has been appointed metallurgical sales engineer of the Copperweld Steel Company, Glassport, Pa. Mr. Brodell was previously with the Timken Roller Bearing Company Steel and Tube Division; the Pittsburgh Crucible Steel Corporation, and the United Alloy Corporation.

Republic Steel Corporation.—*R. W. Helms*, assistant general sales manager of the Berger Manufacturing division of Republic Steel Corporation, has been promoted to the position of general manager of sales, succeeding the late J. W. Strong. *L. S. Hamaker* has been appointed assistant general manager of sales of the Republic Steel Corporation, with headquarters at Cleveland, Ohio.

Mr. Helms entered the service of Berger in 1921 as a cost clerk with the Dallas, Tex., branch, and subsequently served as department manager and branch manager. In 1929, he was transferred to Canton, Ohio, where he joined the general sales staff, and in 1935 was promoted to assistant general sales manager.

L. S. Hamaker

Mr. Hamaker was formerly general manager of the Berger Manufacturing division of Republic Steel at Canton, Ohio. His first contact with the steel industry was as the operator of a billet pusher on a bar mill heating furnace in one of the Canton mills now part of Republic Steel. During World War I, he served in the United States Marine Corps, returning to Canton in May, 1919, to join the sales department of the Berger Manufacturing Company, later transferring to that company's advertising department. In 1925, he became advertising manager of the United Alloy Steel Corporation of Canton, with which the Berger Company had been merged shortly before. When United Alloy was subsequently merged with the Central Alloy Steel Corporation of Massillon, Ohio, he became advertising manager of the latter company in 1930. The Republic Steel Corporation acquired Central Alloy Steel and in 1931 Mr. Hamaker was transferred to Youngstown, Ohio, as sales promotion and advertising manager. When the Berger organization was set up as a division of the Republic Steel Corporation in 1934, he was made general manager and continued as such until his new appointment.

The Westinghouse Electric & Manufacturing Co.—The following have been elected vice-presidents of the Westinghouse Electric & Manufacturing Co.: *Andrew H. Phelps*, Pittsburgh, Pa., manager of purchases and traffic; *L. E. Osborne*, Philadelphia, Pa., manager of the steam division; *Frank C. Reed*, Jersey City, N. J., president of the Westinghouse Electric Elevator Company, a subsidiary; and *Walter C. Evans*, Baltimore, Md.

Victor E. Rennix, until recently associated with the Chicago office of the Baldwin Locomotive Works, is now serving in the motive power section of the transportation equipment branch of the War Production Board at Washington, D. C. When his service there is ended, Mr. Rennix is expected to resume his former duties with the Baldwin Locomotive Works.

(*Turn to next left-hand page*)

PEERLESS EQUIPMENT COMPANY.—*D. S. Hoffman*, assistant vice-president of the Peerless Equipment Company, Chicago, and *Thomas R. Wagner*, formerly assistant district manager of the Sinclair Refining Company, have been elected vice-presidents of the Peerless Equipment Co.

D. S. Hoffman was born in Chicago on October 3, 1904, and graduated from Dartmouth College in 1926. He entered the employ of the Canton Forge & Axle Co., Canton, Ohio, in August of that year and

D. S. Hoffman

in April, 1928, resigned to become associated with the Maintenance Equipment Company, Chicago. In 1930 he joined the P. & M. Company, working out of the San Francisco, Calif., office and in August, 1936, was appointed assistant vice-president of the Peerless Equipment Company at Chicago.

Thomas R. Wagner was born in Philadelphia, Pa., on November 17, 1897, and graduated from Cornell University, Ithaca, N. Y., in 1918. He served in the Marine Corps in World War I and later was employed by

Thomas R. Wagner

the Automobile Blue Book Publishing Company, the Cornell Wood Products Company and the Sun Oil Company. In 1921 he became associated with the Sinclair Refining Company and served as salesman, western manager of the railway sales department and assistant district manager. He resigned from this company to become vice-president of Peerless.

THE MILLER-LEWIS RAILROAD EQUIPMENT CORP. has been appointed representative of the Grip Nut Company, with offices at 80-82 Reade street, New York.

◆

AMERICAN BRAKE SHOE & FOUNDRY COMPANY.—*F. H. Janke*, treasurer of the American Brake Shoe & Foundry Co., has been elected assistant to the president. *Kempton Dunn* succeeds Mr. Janke as treasurer of the company.

◆

FRANK G. LUTH, mechanical superintendent of the Fruit Growers Express Company, has been appointed mechanical superintendent of Iron & Steel Products, Inc., Chicago.

◆

HUNT-SPILLER MANUFACTURING CORPORATION.—*E. J. Fuller*, executive vice-president of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., has been elected general manager. *Victor W. Ellet*, president, will devote more time to corporate matters of the corporation, in addition to his presidential duties. *A. B. Root, Jr.*, has been appointed vice-president; *Frank W. Lampton*, sales manager, and *Joseph Goostray*, assistant general manager.

E. J. Fuller was born in Clinton, Iowa, in 1883. He entered the service of the

Elbert J. Fuller

Chicago & North Western at an early age as a machinist apprentice at Clinton. On completing his apprenticeship, he continued at Clinton as machinist and later was appointed to a supervisory position in the mechanical department. From 1911 to 1913 he was chief inspector of new equipment for the C. & N. W. at the Schenectady, N. Y., plant of the American Locomotive Company. He entered the employ of the Hunt-Spiller Manufacturing Corporation in 1914 and served as mechanical representative until his appointment as assistant sales manager in 1927. He became sales manager in 1928 and was elected executive vice-president in 1936. He now holds the latter position in addition to his duties as general manager.

A. B. Root, Jr., was born in Boston, Mass., in 1886 and was graduated from Tufts College in 1909 with a degree in Civil Engineering. During his early career he was employed in the maintenance of way department of the Boston & Albany and with the Stone & Webster Engineering Corporation as resident engineer on power projects in Montana, Nev., and Georgia. He joined the Hunt-Spiller Manufacturing Corporation as mechanical engineer in November, 1912, and subsequently became assistant to the vice-president,

Albert B. Root, Jr.

assistant to the president, and assistant general manager, and now vice-president.

Frank W. Lampton was born in Fort Scott, Kan., in 1889 and was graduated from a business course at Windsor Business College there. He was employed as

Frank W. Lampton

a machinist apprentice with the St. Louis-San Francisco at Fort Scott from 1907 to 1912, and as machinist from 1912 to 1915. From 1915 to 1917 he served as master mechanic with the Arcadia Coal & Mining Co., Arcadia, Kan., and from 1917 to 1926 was again associated with the St. Louis-San Francisco as night enginehouse foreman at Pittsburg, Kan.; general foreman, Wichita, Kan.; general foreman, Thayer, Mo., and general foreman, south shops, Springfield, Mo. Mr. Lampton joined the Hunt-Spiller Manufacturing Corporation in 1926 as representative in the southwest territory and was appointed to the position of assistant sales manager in 1941, which he held until he became sales manager in March of this year.

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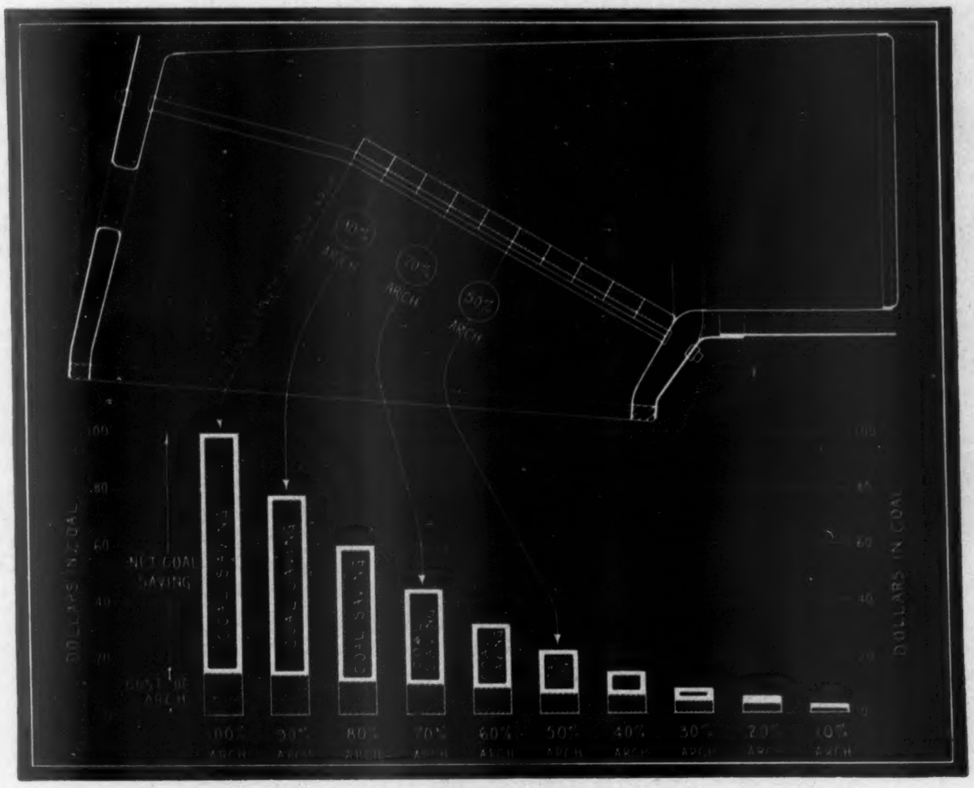

THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

LET THE ARCH HELP YOU SAVE

With the emphasis being placed on saving every railroad dollar, the locomotive Arch becomes increasingly important.

Regardless of the amount of traffic handled, the locomotive Arch saves enough fuel to pay for itself ten times over.

Be sure that every locomotive leaving the roundhouse has its Arch complete with not a single brick nor a single course missing.

In this way, you will get more work for each dollar of fuel expense. Skimping on Arch Brick results in a net loss to the railroad.

THERE'S MORE TO SECURITY ARCHES THAN JUST BRICK

HARBISON-WALKER REFRACTORIES CO.
Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.
Locomotive Combustion Specialists

Joseph Goostray was born in Boston, Mass., in 1890, and received his mechanical engineering training at Northeastern University.

Joseph Goostray

He joined the Hunt-Spiller Manufacturing Corporation in the pattern department in August, 1914. During the first world war he enlisted in the United States Navy and served as chief draftsman in the engineering and repair office at the U. S. submarine base at New London, Conn., returning to the employ of Hunt-Spiller when the war ended. He was subsequently promoted to the positions of assistant mechanical engineer, mechanical engineer, and finally mechanical superintendent in charge of maintenance and operation of mechanical and electrical equipment, and of all the departments in which finished machine products are manufactured by the corporation. He held the latter position until his appointment as assistant general manager.

◆

W. G. MEROWIT has been appointed a representative of the Mahr Manufacturing Company in Western New York State.

◆

E. KUEHN, factory manager of the Electro-Motive Division of General Motors Corporation, has been appointed special representative in railroad transportation.

◆

CARBOLOY COMPANY, INC.—*W. D. Bronson* has been appointed district manager, in the Chicago area, of the Carboloy Company, Inc., Detroit, Mich. *Einar Almdale*, of the general office sales engineering department, has been transferred to the Chicago district as a tool service engineer.

JOHN F. RYAN, vice-president of the Railway Truck Corporation, Chicago, has been appointed sales representative of the railroad division of the Socony-Vacuum Oil Company, Inc., with headquarters at Chicago.

Obituary

C. D. CAREY, manager of railway sales of the Gulf Companies, died April 14. He was 56 years of age.

◆

EDWARD HANSON, assistant to the mechanical superintendent of the Pullman Company, with headquarters at Chicago, died suddenly of a heart attack at Milwaukee, Wis., on May 14.

◆

THOMAS G. WINDES, service engineer of the National Aluminate Corporation, Chicago, died in Evanston, Ill., on May 19 of a heart ailment. He had been in the service of the company 18 years.

◆

MORRIS S. TOWSON, president and general manager of the Elwell-Parker Electric Company of Cleveland, Ohio, died in Orlando, Fla., on March 17. He was 76 years of age.

Personal Mention

General

IVAN R. PEASE, whose promotion to assistant superintendent motive power of the New York, Ontario & Western at Middletown, N. Y., was noted in the May issue, was born on July 7, 1898, at Wilton, Me. Mr. Pease attended the University of Maine and entered railway service on July 1, 1924, with the New York, New Haven & Hartford as a special apprentice. He subsequently served in the New Haven locomo-

Ivan R. Pease

tive shops as gas engine mechanic, foreman of the gas rail car department and production assistant. From 1931 to 1934 Mr. Pease was with the New England Transportation Company (subsidiary of the New Haven) and from 1934 to 1937 was with the Universal Motor Mileage Corporation at Boston, Mass. In 1937 he became test supervisor of the New Haven and in 1941 supervisor of apprentices. He was appointed assistant to superintendent motive power of the New York, Ontario & Western later that year, which position he held until his recent promotion. Mr. Pease will also serve as assistant superintendent motive power of the New York, Susquehanna & Western.

L. E. GRANT, metallurgical and welding engineer of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been appointed engineer of tests.

A. G. HOPPE, assistant mechanical engineer of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been appointed assistant to the mechanical assistant to the chief operating officer, with headquarters at Milwaukee. This is a change of title.

C. F. DENO, district master mechanic of the Manitoba district of the Canadian Pacific, with headquarters at Winnipeg, Man., has been appointed to the newly created position of chief of motive power for Western Canada.

N. R. CRUMP, assistant superintendent of motive power of the Canadian Pacific at Winnipeg, Man., has been appointed assistant to the vice-president at Montreal, Que. Mr. Crump was born at Revelstoke, B. C., on July 30, 1904, and attended the public schools of Revelstoke and Vancouver, receiving his B.Sc. and M. E. degrees from Purdue University, Lafayette, Ind., in 1929. Mr. Crump entered railroad service with the Canadian Pacific in 1920 as a machinist apprentice at Field, B. C., transferring to the Weston shops at Winnipeg two years later. He then attended Purdue University from 1925 to 1929, returning to Winnipeg as machinist. In 1930 Mr. Crump became night foreman at Sutherland, Sask., subsequently becoming shop foreman at Lethbridge, Alta., and Calgary, successively. He then served as locomotive foreman at Wilkie, Sask., night foreman at Moose Jaw, Sask., and division master mechanic there,

N. R. Crump

being transferred to Regina, Sask., in 1936. In 1939 he was appointed chief mechanical draftsman for Western lines at Winnipeg and in 1940 he became assistant superintendent of motive power for Western Canada, which position he held until his recent promotion.

L. B. George, division master mechanic on the Canadian Pacific at Lethbridge, Alta., who has been appointed works manager of the Weston shops at Winnipeg, Man., as noted in the May issue, was born on April 14, 1896, at Ashton-in-Makerfield, England. Mr. George entered railway service on December 5, 1910, with the Canadian Pacific and was employed as a messenger, clerk and machinist apprentice in the mechanical department at Vancouver, B. C., until September, 1914, when he enlisted with the Canadian Expeditionary Force. In July, 1919, he returned to the Canadian Pacific and completed his apprenticeship. He then served as a machinist and relief locomotive foreman at Vancouver and in August, 1929, became shop foreman at West Calgary, Alta. Mr. George was transferred to Alyth, Alta., in March, 1930, and in July, 1932, became assistant machine shop foreman at the Weston shops. In September, 1934, he was promoted to the position of shop engineer at the Weston shops and in October, 1934, to machine shop foreman. He was general locomotive foreman at Vancouver from July, 1936, until May, 1940, when he was loaned to the Canadian Associated Aircraft Company to study aircraft manufacture in England. In September, 1940, he was appointed division master mechanic of the Canadian Pacific

L. B. George

at Lethbridge, Alta., and in July, 1941, was loaned to the Canadian federal government as assistant supervisor of Aircraft Production, Department of Munitions & Supply, at Ottawa, Ont. Mr. George was appointed to the position of supervisor of Aircraft Production for Canada in September, 1941, in which position he was active until his appointment as works manager of the Weston shops.

Harry G. Miller, engineer of tests of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been appointed assistant mechanical engineer.

Master Mechanics and Road Foremen

J. S. Bell, assistant master mechanic of the Pittsburgh division, on the Pennsylvania, has been promoted to master mechanic of the Middle division, at East Altoona, Pa.

H. C. Wright, master mechanic on the Middle division of the Pennsylvania, with headquarters at East Altoona, Pa., has been transferred to the Juniata shop.

Barry Glen has been appointed master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Miles City, Mont.

J. G. Danneberg, who has been appointed master mechanic on the Atchison, Topeka & Santa Fe at Arkansas City, Kan., as noted in the May issue of the *Railway Mechanical Engineer*, was born on May 28, 1896, at Kansas City, Kan. On November 17, 1913, he entered the service of the Santa Fe as a machinist apprentice at the Argentine enginehouse. He completed his apprenticeship on August 11, 1917, and worked as a machinist at Argentine, Kan., and Emporia, Kan., until September 22,

J. G. Danneberg

1923, when he became day enginehouse foreman at Emporia. He became day machinist gang foreman at Emporia on August 6, 1931, and master mechanic at Arkansas City on April 15, 1942.

G. R. Thomas has been appointed road foreman of engines of the Kootenay division of the Canadian Pacific.

J. L. Carmichael has been appointed road foreman of engines of the Revelstoke (B. C.) and Kettle Valley divisions of the Canadian Pacific.

W. A. Cunningham has been appointed road foreman of engines of the Canadian National, with jurisdiction over the Montreal terminals and assigned to Turcot, Que.

A. J. Pentland, district master mechanic of the Saskatchewan district of the Canadian Pacific has been transferred to Winnipeg, Man.

D. Beath, division master mechanic on the Canadian Pacific at Winnipeg, Man., has been promoted to acting district master mechanic of the Saskatchewan district, with headquarters at Moose Jaw, Sask.

G. S. Webb, assistant master mechanic of the Pennsylvania at Columbus, Ohio, who has been appointed master mechanic, with headquarters at Chicago, as announced in the April issue, was born in New Athens, Ohio, on April 20, 1897. After his graduation in 1920 from the University of Illinois, where he studied railway electrical engineering, Mr. Webb entered the service of the Chicago Elevated Railroad and the Chicago, North Shore & Milwaukee. On October 22, 1920, he became a draftsman in the electrical engineer's office on the Pennsylvania at Altoona, Pa. He then served, successively, as special electrical apprentice, motive-power inspector and assistant master mechanic on the West Jersey & Sea-

G. S. Webb

shore, Long Island and Philadelphia Terminal division of the Pennsylvania. Mr. Webb was later assistant foreman in the electrical engineer's office; foreman of the Wilmington electrical shop; general electrician of the eastern region, and most recently assistant master mechanic at Columbus.

Alfred Boyd Atkinson, general foreman on the Illinois Central at Centralia, Ill., who has been appointed master mechanic, with headquarters at Memphis, Tenn., as noted in the May issue, was born on February 5, 1895, at Summit, Miss. He

A. B. Atkinson

attended high school for three years and entered the service of the Illinois Central on August 7, 1912, as a machinist apprentice at McComb, Miss. From August 7, 1916, to January 1, 1918, he was a machinist at McComb. On the latter date he became dead work foreman. He was again a machinist at McComb from March

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Time
GREAT NORTHERN
THE MILWAUKEE ROAD
540
Rio Grande
540
SOUTHERN
6100
6100

Everything

TIME is priceless. Fighting men cannot wait. Every minute — every hour — every day counts. One battleship this year is worth two in 1943. A thousand planes in 1942 are worth ten thousand in 1943.

In this battle of production, the railroads are faced with their biggest job in history — that of speeding America's enormous and ever increasing tonnage of materials, supplies and equipment, requiring the service of every available piece of rolling stock, especially locomotives.

In meeting this challenge, General Motors Diesel Road Locomotives are making possible many operating advantages which are vital to America at war, such as: — reduction in train miles as much as 50 per cent — faster schedules with fewer service delays — increased tonnage hauling capacity — and for each Diesel operated will release as many as five steam locomotives for other important services. And as more Diesels go into service, America's transportation network becomes that much stronger.

WHO SERVES THE RAILROADS—SERVES AMERICA

ENERAL OTORS

1, 1918, until April 21, 1926, when he became air-brake machinist at Gulfport, Miss. He became night work foreman at Gulfport on September 16, 1926; extra work, on September 28, 1929; machinist at Asylum, Miss., October 31, 1929; machinist at Canton, Miss., May 16, 1931; machinist at Asylum, August 6, 1932; engine dispatcher, June 16, 1933; gang foreman, July 1, 1936; general foreman, July 15, 1939; general foreman at McComb, May 1, 1940; general foreman at Centralia, February 16, 1941, and master mechanic at Memphis, March 1, 1942.

Car Department

C. E. Barrett has been appointed general car foreman of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Minneapolis, Minn.

E. Buchholtz, general car foreman of the Chicago, Milwaukee, St. Paul & Pacific at Minneapolis, Minn., has been transferred to the position of general car foreman at Chicago.

H. L. Ewing, general car foreman of the Chicago, Milwaukee, St. Paul & Pacific, has been promoted to the position of general car-department supervisor, Northern district, with headquarters at Minneapolis, Minn.

A. C. Schroeder, general car-department supervisor of the Northern district of the Chicago, Milwaukee, St. Paul & Pacific at Minneapolis, Minn., has been transferred to the Southern district, with headquarters at Chicago.

F. J. Swanson, general car-department supervisor of the Southern district of the Chicago, Milwaukee, St. Paul & Pacific at Chicago, has been granted a leave of absence to enter military service.

Norman H. Camp, car foreman of the Chesapeake & Ohio at Handley, W. Va., has been appointed assistant general car foreman at Columbus, Ohio.

D. L. Ringler has been appointed general car inspector of the Texas & Pacific, with headquarters at Dallas, Tex., temporarily in place of J. D. Clyde, Sr.

C. G. Miller, car foreman on the Norfolk & Western at the Pulaski shops, Pulaski, Va., has been transferred to Bristol, Va.

A. O. Walker, tool car foreman of the Chesapeake & Ohio at Clifton, Forge, Va., has been promoted to the position of car foreman, with headquarters at Handley, W. Va.

W. I. Stultz, car department gang leader on the Norfolk & Western, with headquarters at Shaffers Crossing, Roanoke, Va., has become car foreman at Pulaski, Va.

Chas. A. Jordan, general car inspector of the New York, Chicago & St. Louis at Cleveland, Ohio, has been appointed to the newly created position of assistant to superintendent car department, with headquarters at Cleveland. Mr. Jordan entered railway service in 1915 with the Chesapeake & Ohio in the mechanical engineer's office at Richmond, Va. He became engineer of freight-car construction in 1924, and in 1929 was transferred to Cleveland as elevation engineer—cars, in the office of chief mechanical engineer of the Advisory Mechanical Committee of the C. & O., the Erie, the New York, Chicago & St. Louis, and the Pere Marquette. In 1933 he was appointed chief draftsman—cars, in the same department, and in 1937 became general car inspector of the Nickel Plate.

Orlin Hoyd Clark, general car inspector of the Gulf Coast Lines and the International-Great Northern (both parts of the Missouri Pacific), with headquarters at Houston, Tex., who has been appointed assistant superintendent of the car department of the Missouri Pacific at St. Louis, Mo., as noted in the May issue, was born on July 22, 1897, at Borden, Ind. Mr. Clark attended high school and commercial law school at Louisville, Ky., for two years. On November 20, 1914, he entered the employ of the Louisville & Nashville at Louisville and served successively as car repairer helper, car repairer, A. A. R. checker, A. A. R. clerk, chief A. A. R. clerk and traveling A. A. R. inspector On October 25, 1924, he began service with the Missouri Pacific at St. Louis as assistant general car inspector, and on July 24, 1926, was appointed supervisor car repair bills at Houston, Tex. He became general car inspector on February 15, 1939.

O. H. Clark

Shop and Enginehouse

K. E. Flora, work inspector of the New York Central at Beech Grove, Ind., has been promoted to the position of piecework inspector.

J. H. Staley, piecework inspector of the New York Central at Beech Grove, Ind., has been promoted to the position of assistant foreman.

Otto Hildebrandt, assistant foreman of the New York Central at Beech Grove, Ind., has been promoted to the position of foreman.

E. K. Staley, assistant foreman, boiler department, of the Chesapeake & Ohio at Huntington, W. Va., has been promoted to the position of foreman, boiler department, with headquarters at Huntington.

J. J. Stopek, work inspector of the New York Central at Beech Grove, Ind., has been promoted to the position of piecework inspector.

J. W. Brooks has been appointed assistant foreman, boiler department, of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

Purchasing and Stores

N. L. Satchell, storekeeper of the New York, Ontario & Western, at Middletown, N. Y., has been appointed general storekeeper.

N. T. Womack has been appointed assistant purchasing agent of the Texas & Pacific, a newly created position, with headquarters at Dallas, Tex.

Arthur N. Crenshaw, assistant purchasing agent on the Great Northern, at St. Paul, Minn., has been promoted to the position of purchasing agent, with the same headquarters.

Abner H. Lillengren, purchasing agent of the Great Northern at St. Paul, Minn., has retired on account of illness.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

Bronze Welding Alloys.—Bridgeport Brass Co., Bridgeport, Conn. Bronze welding suggestions with information of the rods available and their characteristics.

◆

Eureka Tool Steel Welding Wires.—Welding Equipment and Supply Company, Detroit, Mich. Information on the reclamation of worn tools and the opportunities for composite construction of new tools.

◆

Welding Rods.—The American Brass Co., Waterbury, Conn. A description of Anaconda welding rods with fairly detailed explanations of their uses and methods of application by various welding practices.

◆

Safety Equipment Catalogue.—American Optical Co., Southbridge, Mass. A description of the complete line of welding accessories to protect workmen. Also includes other shop safety equipment for individuals.

◆

Tungsten Electrodes.—Vascoloy-Ramet Corporation, North Chicago, Ill. Four-page Bulletin W-421. Describes pure tungsten electrodes for atomic hydrogen welding, with specifications of full range of sizes of these electrodes.